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ANNUAL REPORT ON SILVICULTURAL RESEARCH

IN THE

MADRAS PRESIDENCY

FOR THE YEAR

1936-37

PART I

RESULTS—WORKING PLANS—STATISTICS—STAFF

PART II

EXPERIMENTAL DATA

M.F.C.
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ANNUAL REPORT ON SILVICULTURAL RESEARCH IN THE MADRAS PRESIDENCY FOR THE YEAR 1936-37.

PART I.

I. RESULTS AND INDICATIONS.

(i) (*a*) GENERAL.

1. As in previous years, a large amount of the work done this year has been small scale [Stage I (*a*)] investigations in experimental gardens. Inevitably, a large proportion of the work consisted of repetitions of previous experiments in order to confirm the results and indications obtained from them, and also of routine seed germination and weighment tests.

2. The most important results obtained during the year are probably the following :—

Further demonstration of the necessity for 'rab' regeneration in dry fuel forests. Apart from the mortality caused by man, grazing, fire, etc., the ordinary coppice felling causes about 7 per cent of the stools to die each time the operation is done and preliminary counts show that natural regeneration is very scarce indeed and of the order of three seedlings per acre.

Improvement in district "rab work," particularly in the successful raising of forest crops in conjunction with field crops (such as ragi and castor in Madura district and cotton in Salem Central division).

Demonstration of the great benefits of soil working in the first year of 'rab' regeneration in dry fuel forests.

Collection by experiment of statistics of teak stump production in nurseries and the methods by which economies can be made. In conjunction with this is the demonstration of the fact that in years of shortage, undersized stock in the nursery can be developed into good stock for the following year. These results are particularly important in view of the very poor seed year that occurred last year and the resulting shortage of stumps that followed.

Summary of five years' experimental work at three centres in pre-monsoon stump planting of teak.

Large scale confirmation by districts of experimental work in the pre-monsoon stump planting of teak and of the beneficial effect of using stumps of the best size.

The improvement of our knowledge of the regeneration and working of bamboos.

The continued success in the control of new outbreaks of the spike disease of sandal.

The summary by the Forest Entomologist, Dehra Dun, of the results of the investigation into the spike disease of sandal.

The further confirmation that *Lantana* can be controlled by chemical spraying and that this method is the cheapest method found so far.

3. Owing to the increase in office staff last year and the consequent reorganization of the office, during the year under report all arrears of both office and accounts work and the maintenance of experimental records have been worked off and we are now up to date. In addition we are coming to the end of a number of investigations in mixed deciduous forest which were started four and five years ago and in consequence in the coming year new investigations will be started chiefly in the regeneration of evergreens and Mahogany (as a result of the visit of the Provincial Silviculturist to Bengal) and also in the regeneration of areas of mixed deciduous forest which are not fit for teak plantations. This latter work is a direct result of the general failure of gap regeneration work in such areas.

(*b*) CLIMATES.

4. In an endeavour to give an idea of the climates in which the experiments have been done, a rainfall statement for all research centres is given in paragraph 274. In this statement the rainfall figures are given in inches month-war and underneath this is given the number of rainy days in that month, e.g.,

$$\frac{10\cdot71 \text{ (inches of rain in the month).}}{15 \text{ (rainy days in the month).}}$$

In addition to this, the last column of the table gives the average annual rainfall of the place over as long a period of years as is possible together with the average number of rainy days per year where it is known. The period of rainfall given (1st April 1936 to 1st June 1937) covers all the 1936 experiments. The rainfall is totalled for the year 1st April 1936 to 1st April 1937 as this period covers most measurements and is to be compared with the average annual rainfall given in the last column.

1936 was the third consecutive abnormal year climatically. In districts having a West Coast type of climate the hot weather was unusually severe with a lack of the normal pre-monsoon thunder showers and the South-West monsoon broke in most places about a fortnight earlier than usual. In the dry districts rainfall was fairly normal in season although in general it was well below average in quantity. It was a fair seed year in the wet districts and a rather poor seed year in the dry districts.

(ii) NATURAL REGENERATION.

By seed.

5. *Attempts to induce natural regeneration under mother trees—Hopea parviflora.*—In experimental plot No. 54, South Coimbatore division, *Hopea* mother trees were selected and in half the ground projection of the crown, weed growth was removed and the soil raked just before seed fall. This was started in 1933 and each year since that date the existing natural seedlings have been counted, pulled out, and the treatments repeated.

During the four years that have elapsed there has been very little seed fall but enumerations show that the treatment has had no beneficial effects in inducing natural regeneration as the numbers of seedlings resulting in the treated and untreated plots are almost exactly the same. The effect of a full seed fall remains to be seen.

6. *Calophyllum elatum.*—Experimental plot No. 56, South Coimbatore division, which is a similar experiment has given no results as there has been practically no seed fall at all since the experiment was started four years ago.

7. *Mesua ferrea.*—Experimental plot No. 23, Wynaad division, and 55, South Coimbatore division, are similar experiments with *Mesua*. Seed fall with this species has been very slight during the last four years but the treatment has shown no beneficial or deleterious effects.

8. *Swietenia macrophylla.*—It is very noticeable that some mahogany mother trees produce abundant natural regeneration under them while others produce little or none. Previous experiments to induce regeneration where it is absent or scanty by clearing undergrowth and raking the soil have proved unsuccessful. To continue this investigation experimental plot No. 142, Nilambur division, has been started in which burning has been added to the above treatments. It is too early yet to draw any conclusions.

In experimental plot No. 141, Nilambur division, mature seed bearers which bear normally a fair amount of fruit but which produce little or no regeneration have been selected. The fate of the fruits and seeds until seed fall, the quantity and quality of the seed that falls and the quantity and fate of regeneration produced are all to be observed. The object of the experiment is to try and find the reason for the lack of regeneration but sufficient time has not yet elapsed to draw any conclusions.

9. *Canopy manipulation over natural regeneration—Hopea parviflora.*—Experimental plot Nos. 37, 38 and 39, South Coimbatore division, were opened in 1931 in Karian shola to study the effect of canopy manipulation on natural regeneration of *Hopea*

parviflora 5′ - 10′ high. Three treatments were applied in which (A) all but the top canopy was cut, (B) the undergrowth was cut and (C) control in which nothing was done.

Casualties have been negligible and during the six years the plots have been open the treatments have shown the following average annual height increment: (A) 14·6″, (B) 6·5″ and (C) 7·5″. Although the experiment has been primarily concerned with regeneration 5′ - 10′ high the treatments have shown the following recruitment to regeneration over 3′ high: (A) + 21 per cent, (B) + 18 per cent and (C) - 11 per cent.

The above figures well demonstrate the benefit obtained by the canopy opening. The plants in the area where the undergrowth was cut (B) have put on a fair girth increment but have suffered from bark stripping by deer.

10. Experimental plot Nos. 42 and 43, South Coimbatore division, were opened in 1932 in Karian shola to study the effect of canopy manipulation on unestablished natural regeneration of *Hopea parviflora*. Two treatments were applied in which (A) all but the top canopy was removed and (B) control in which nothing was done. In addition in the A treatment part was fenced and the remainder left unfenced.

During the time the plots have been opened the unestablished regeneration in the three treatments has shown the following average annual percentage increase :—

A_1 Top canopy—fenced—145 per cent.

A_2 Top canopy—unfenced—101 per cent.

B Full evergreen shade—unfenced control—20 per cent.

These figures well illustrate that to establish young regeneration of *Hopea* it is very beneficial indeed to open the canopy.

11. *Mesua ferrea*.—Experimental plot Nos. 44 and 45, South Coimbatore division, were opened in 1932 to test the effect of canopy opening on natural regeneration of *Mesua ferrea* 5′ - 10′ high. Two treatments were applied (A) in which only the top canopy was left and (B) the control in which nothing was done. The two treatments show an average annual height increment of (A) 9·0″ and (B) 5·7″ but the small regeneration on the ground is not quite as good as it was.

12. Experimental plot Nos. 3 and 4, Wynaad division, were opened in 1932 and two treatments applied: (A) Cutting undergrowth and (B) Control. They show an average annual height increment of (A) 4·2″ and (B) 1·7″. The state of small regeneration on the ground has not moved.

13. Experimental plot Nos. 5 and 6, Wynaad division, were similarly opened in 1932. In these two experiments the treated and control plots have shown a mean annual height increment of

4·9″ and 4·6″, respectively, and the small regeneration on the ground has not moved at all.

The above experiments show that for *Mesua ferrea*, it is not advantageous to open the canopy or remove undergrowth at least before the natural regeneration is 5′ – 10′ high.

14. *Pterocarpus santalinus* (Red sanders).—A valuable species in some of the dry districts often regenerates itself by seed profusely but the regeneration dies back each year although it increases in density year by year. The District Forest Officer, Chittoor, has been very successful in bringing on this regeneration into a sapling and pole stage by opening the canopy over a ' mat ' of seedlings which was considered dense enough to open over.

This procedure has also been recognized in other districts but no records have been kept of work done and no counts made to give an idea of when regeneration is sufficient to start operations. Controlled experiments with this object were started last year and preliminary counts showed that this ' mat ' of regeneration contains approximately 550 seedlings per 100 square feet.

Although the year has been a poor one climatically with only two-thirds of the normal rainfall, enumerations show that the established regeneration class (over 3 feet high) has increased by 106 per cent while the total number of seedlings has decreased due to early dying back of younger seedlings by only 5 per cent. The treatment of opening the canopy by 30 per cent to 50 per cent has thus been markedly successful in the first year.

15. *Necessity for the artificial regeneration of coppice coupes in dry fuel forests.*—In the past few years experiments in coppice coupes in dry fuel forests have shown that each coppice felling causes a mortality of about 5 per cent of the stools.

During the year enumerations were done over quite large areas in coupes that were felled five years ago to determine to what extent natural regeneration has tended to make good this mortality due to the coppice felling. The enumerations showed that natural seedlings were present only to the extent of 3 per acre and had a maximum height of 3½ feet and an average height of just under 2 feet.

The above facts clearly demonstrate the necessity of the artificial regeneration of dry fuel forests which are worked under a simple coppice system.

16. *By coppice.*—In experimental plot No. 11, Chittoor division, three species (*Acacia sundra, Albizzia amara,* and *Azadirachta indica*) were dealt with and three treatments applied (1) high cutting, with trimming, (2) low cutting with trimming, (3) low cutting without trimming. The fourth treatment of high cutting without trimming was omitted as a sufficient number of stools were not available and it was considered best to get more reliable results with fewer treatments.

Measurements two years after applying treatments show the following mortalities of stools :—

Species.	High cutting with trimming.	Low cutting with trimming.	Low cutting without trimming.	
	Percentage of stools dead.			
Acacia sundra	3·6	11·9	10·1	
Albizzia amara	2·5	7·7	6·0	
Azadirachta indica	3·8	5·9	..	Treatment omitted owing to insufficient number of stools.
Averages for all three species.	3·3	8·5	8·1	

The three treatments in ordinary district work correspond to good, poor and very poor work, and it is seen that for all three treatments and all three species (1,224 stools) the ordinary operation of coppicing has caused 6·6 per cent mortality.

This comparatively high mortality once again brings into prominence the necessity for 'rab' regeneration in fuel forests to make up the loss of stock caused by coppice felling.

It is to be noted that the highest mortality in all species has been caused by the treatments of low cutting and this in practice has been considered to be the best type of work. It is possibly due to the shaking of the roots in a dry soil.

It will of course be many years before we can determine the effect of the treatments on the volume of fuel produced.

It is to be noted that further casualties have occurred during the year in both the low cutting treatments.

17. *Natural regeneration by coppice—Mimusops hexandra.*— An interesting experiment on the effect of the height of cutting in coppicing this species was done in the Tanjore forests. The trees experimented with were divided into three girth classes (i) 6″ to 12″, (ii) 12″ to 18″ and (iii) 18″ to 24″ and two treatments were applied to each girth class ; (A) high cutting at 9″ to 1′ above ground level and (B) low cutting as close to the ground as possible.

Results show that the height of the resultant shoots is much the same for all six treatments.

The figures of the mortality of stools are as follows and are very striking.

Mortality of stools.

Girth class.	High cutting. PER CENT.	Low cutting. PER CENT.
6″ to 12″	6	55
12″ to 18″	17	68
18″ to 24″	48	92

The above figures are those of a single experiment and need confirmation by repetition but they give very definite indications that (i) low cutting produces a very high mortality indeed and (ii) even with high cutting the mortality increases very rapidly with girth.

In some of the coastal forests this species is the main species and if they are to be worked on a simple coppice system the trees must not be allowed to reach a medium or large size or the coppicing will devastate the forests. Further experiments on the natural and artificial regeneration of this species are obviously very urgently needed.

18. *Effect of thinning teak coppice shoots* 18 *months after the coppice felling.*—In experimental plot No. 142, Palghat division, an experiment has been started to determine whether it is advisable to thin out teak coppice when grown for the purpose of producing poles. The thinning out was done when the coppice was 18 months old and of course produced secondary shoots but two years later these secondary shoots although vigorous were in no way interfering with the original coppice shoots.

Measurements two years after treatment (or four years after the coppice felling) show that all treatments in which the number of coppice shoots per stool were reduced, have produced coppice shoots considerably bigger in height and diameter than the untreated control. It however remains to be seen which treatment gives the greatest money yield at the end of the rotation.

Abbreviated results are—

Treatment.	Mean height in feet.	Mean diameter in inches.
A. Reduction to 1 shoot per stool	21·30	2·27
B. Do. 2 do.	18·20	1·84
C. Do. 4 do.	17·70	1·43
D. Untreated control	13·59	1·15

(iii) SEED.

19. *Seed pre-treatment.*—Routine seed pre-treatment tests were made with 21 species, the treatments used being cold, hot, and boiling water, with an untreated control in each case. Seed purity percentage and seed weights were also recorded.

The germinative capacity of seed of the following species was not apparently improved by any of the treatments used :—

Acacia ferruginea.
,, *leucophlœa.*
,, *melanoxylon.*
,, *planifrons.*
,, *sundra.*
Acrocarpus fraxinifolius.
Albizzia amara.
,, *lebbek.*
Anacardium occidentale.
Azadirachta indica.
Calophyllum elatum.
Cassia fistula.
Cassia marginata.
,, *siamea.*
Chloroxylon swietenia.
Dalbergia latifolia.
,, *sissoides.*
Dendrocalamus strictus.
Dolichandrone crispa.
Gmelina arborea.
Harrisonia bennetii.
Juniperus procera.

Lagerstrœmia lanceolata.
Meliosma wightii.
Pitchecolobium dulce.
Prosopis juliflora.
Pterocarpus dalbergioides.
,, *marsupium.*
Schleichera trijuga.
Tectona grandis.
Terminalia chebula.
,, *crenulata.*
,, *paniculata.*
Vitex altissima.
Wrightia tinctoria.
Zizyphus jujuba.

20. Treatment with boiling water (water 20 times the volume of the seed used is brought to the boil, taken off the fire, the seed immediately put in and left till cold) appears to increase the germination of *Acacia auriculiformis*, *Acacia cyanophylla* and *Acacia dealbata*, the latter two species being very marked.

21. Soaking in cold water for 24 hours was beneficial in the cases of *Gluta travancorica*, *Pterocarpus santalinus* and *Xylia xylocarpa*, being very marked in the case of the *Pterocarpus* (Red sanders). It is again brought to notice that the pre-treatment of teak seed by soaking it in cold water neither increases nor accelerates its germination.

22. Soaking in hot water as hot as the hand can bear and then allowing to cool was beneficial in the case of *Zizyphus incurva.*

23. The results of pre-treatment tests are summarized in the table below. Generally 100 seeds for each treatment were uesd in each test though in a few cases 200 or 50 seeds were used. The results of previous years' tests are included.

Species.	Number of tests made.	Average germinative capacity with				marks.
		Untreated.	Cold water.	Hot water.	Boiling water.	
Acacia auriculiformis	6	14	14	19	22	Boiling water best in 5 out of 6 tests.
Do. *cyanophylla*	9	11	14	17	35	Boiling water best in 8 out of 9 tests.
Do. *dealbata*	6	45	68	60	87	
Do. *ferruginea*	6	55	49	53	51	
Do. *leucophlœa*	10	19	9	14	24	
Do. *melanoxylon*	1	83	81	91	90	
Do. *planifrons*	1	22	14	12	8	
Do. *sundra*	10	34	28	30	25	
Acrocarpus fraxinifolius	25	8	8	9	6	
Albizzia amara	18	42	37	30	38	
Do. *lebbek*	1	20	13	10	11	
Anacardium occidentale	6	70	58	54	24	Untreated seed consistently best.
Azadirachta indica	6	44	40	30	9	
Calophyllum elatum	5	17	16	13	0	
Cassia fistula	13	11	11	8	7	
Cassia marginata	12	17	22	13	5	
Cassia siamea	13	52	36	46	3	
Chloroxylon swietenia	11	14	12	11	1	
Dalbergia latifolia	22	31	26	29	5	
Dalbergia sissoides	30	26	26	32	5	
Dendrocalamus strictus	5	33	22	22	0	
Dolichandrone crispa	1	14	7	6	4	
Gluta travancorica	6	23	29	23	21	
Gmelina arborea	25	20	19	18	6	
Harrisonia bennetii	3	12	18	9	7	
Juniperus procera	1	6	7	9	2	
Lagerstrœmia lanceolata	30	5	4	4	0	
Meliosma wightii	1	14	8	0	0	
Pithecolobium dulce	8	43	13	38	5	

Species.	Number of tests made.	Average germinative capacity with				Remarks.
		Untreated.	Cold water.	Hot water.	Boiling water.	
Prosopis juliflora	5	71	72	61	54	
Pterocarpus dalbergioidus	3	16	15	9	5	
Do. santalinus	12	25	71	33	19	
Do. do.	1	24	40	33	10	Seed coat removed.
Do. marsupium	62	38	32	32	14	
Schleichera trijuga	4	9	10	5	0	
Tectona grandis	40	28	27	24	8	
Terminalia chebula—						
(1) (whole fruit)	10	18	12	21	3	
(2) (fleshy covering removed) ..	3	4	6	5	7	
(3) (kernel)	4	6	1	2	0*	* Damaged by white ants.
Terminalia crenulata—						
(1) fresh seed	62	32	35	30	6	
(2) stored 14 months	10	9	8	7	8	
Terminalia paniculata	10	13	8	10	0	
Vitex littoralis	2	30	38	11	0	
Wrightia tinctoria	1	11	9	5	3	
Xylia xylocarpa	42	20	26	25	13	
Zizyphus incurva	1	55	53	69	48	
Do. jujuba	1	9	10	9	8	

24. *Seed pre-treatment—obdurate species.*—Seven species which usually give a very low germination per cent were experimented on with special tests to try and increase their germination.

The treatments used were (A) control, (B) soaking in lime water for 24 hours, (C) soaking in cold water for 48 hours and then keeping moist in straw out of free air circulation (fermenting), (D) scorching over a fire, (E) soaking in concentrated sulphuric acid and (F) exposing to the sun and watering on alternate days.

Results including those of previous years are seen in the table below :—

Species.	Number of tests.	Control.	Lime water.	Fermenting.	Scorching.	Sulphuric acid.	Weathering.
Acacia auriculiformis	20	8	*	8	*	5	8
Acacia leucophlœa	30	14	*	15	0	13	9
Acrocarpus fraxinifolius	11	14	0	12	*	*	7
Cassia fistula	30	10	9	7	0	30	5
Cassia marginata	11	22	13	10	0	36	*
Pterocarpus santalinus	30	27	*	22	2	9	11
Terminalia chebula	30	15	9	30	16	0	6

* Test not done.

25. Concentrated sulphuric acid hastened and greatly improved the germination of *Cassia fistula* and *Cassia marginata* while fermenting greatly improved that of *Terminalia chebula*.

26. *Seed—seasonal collection within the fruiting season.*—Tests were made of seed collected at fortnightly intervals throughout the fruiting season of 10 species, *Acacia leucophlœa*, *Artocarpus hirsuta*, *Cassia fistula*, *Cassia marginata*, *Mesua ferrea*,

Pterocarpus santalinus, *Shorea talura*, *Swietenia macrophylla*, *Terminalia chebula* and *Terminalia paniculata*. In each case these seed collections covered a period of six weeks to two months but in no case were there any definite variations in germinative capacity throughout the fruiting season.

With each species and each date of collection 10 separate tests of 100 seeds each were done.

27. *Method of sowing—Hopea parviflora.*—*Hopea* seed was sown (i) with the wings vertical (in the position it falls through the air), (ii) on its side (in the position it normally lies on the ground) and covered with earth to a depth of one-eighth inch and (iii) on its side but well covered with half inch of soil. The average germination of 10 tests was (i) 10 per cent, (ii) 23 per cent, (iii) 27 per cent. It therefore appears that *Hopea* seed should be sown on its side and well covered with earth to get the best results.

28. *Removal of pulp from seed—Santalum album.*—Seed of *Santalum album* from which the pulp had been removed before sowing gave consistently better results than seed with the pulp left on. In 40 tests of each the average germinative capacities were with pulp 9 per cent and without pulp 33 per cent. The pulp of this seed should therefore always be removed before sowing.

29. *Removal of outer coat—Pterocarpus santalinus.*—Ten tests made by removing the outer coat of the seed of *Pterocarpus santalinus* showed that this treatment resulted in the germinative capacity being nearly doubled. These tests need confirmation by repetition.

30. *Seed, locality test—Santalum album.*—Sandal seed was collected from both the spring and autumn crops from five localities, Coorg, Javadis, North Coimbatore division, North Salem division and the Nilgiris. This seed was tested by monthly sowings.

The spring crop seed (collected in March) was found slightly better in germinative capacity than autumn seed (collected in November). Both seed crops kept equally well in air-tight jars or in gunny bags for nine months but after this very quickly lost their vitality.

31. *Weathering of seed—Teak.*—Experiments were carried out at three centres in the weathering of teak seed. At each centre 10 tests of 100 seed each were carried out for each of four treatments, (A) seed exposed to sun and rain for six weeks, (B) as (A) but watered once a week in dry weather, (C) seed buried in pits in wet straw, (D) control. The treatments produced no appreciable difference in germination percentage.

32. *Method of collection—Swietenia macrophylla.*—An experiment was done at Kannoth in which mahogany seed was collected at three intervals of a fortnight in the fruiting season in the following ways: (A) capsule obviously unripe, (B) capsules ripe on the

tree, (C) capsules which had started to open, half the seed being collected off the ground and the other half from the capsule. All the seed was sown on the dates of collection. There was no appreciable difference in germination percentage between any dates or any treatments.

33. *Santalum album—peculiar variety.*—In the course of the investigation into the spike disease of sandal, in Noganur Reserve Forest of North Salem division a tree was found which had all the outward characteristics of the disease but it was noticed that the usual progression towards death in a few years did not occur. The tree has now been under observation for some ten years and it is still growing in healthy proportions although it has the spike-like appearance. It has produced some root suckers all of which are like the parent tree. Repeated efforts to transmit the peculiar appearance to healthy trees by grafting have failed.

It is being kept under close observation as it is possibly a strain of sandal immune to the disease. During the year it seeded profusely. The seed is normal in appearance, in weight, in germinative capacity and plant per cent. Some of the plants raised from this seed are normal in appearance and some like the parent tree but of course they are too young yet to say how they will turn out. The tree is locally known as the "Peculiar Sandal tree."

34. *Seed storage.*—Routine storage tests were made with 24 species with different methods of storage. Results showing the lengths of time that seed of the different species remains fertile are given in the table in paragraph 275 in which previous years' results are included. It should be noted that the table gives indications of the probable longevity of the seed but many more tests are necessary before reliable results can be obtained.

35. *Seed weighments.*—Routine seed weighments, germination tests, etc., were carried out. The results are given in paragraph 276 in the form given in the "Note on the weight of seed (Revised)" by S. H. Howard and H. G. Champion. (Forest Bulletin No. 41—1928.)

36. *Seed statistics—Cassia siamea.*—Seed of this species is getting more and more in demand each year as 'rab' work is extending so rapidly. It is now evident that for some years, until a number of early 'rab' plots start yielding seed in quantity, we are not producing enough seed of this species to meet the requirements of this Presidency. In consequence, seed indents are often only complied with in part and it is very noticeable that some districts are overestimating their requirements and in consequence when proportional supply is made this is not fair to districts that have estimated correctly.

It is a comparatively new seed to many officers and their attention is drawn to the statistics given in paragraphs 275 and 276 of this report.

In addition, reports have been collected from two or three districts where 'rab' is an established and successful practice. They report as follows :—

(i) One gunny bag of ripe pods gives 1 Madras measure or roughly 2 lb. of cleaned seed.

(ii) One-third Madras measure of seed or two-third lb. of seed is sufficient to allow for sowing and all resowings even in a bad season for a standard rectangular 'rab' plot of 50′ × 20′ which has approximately 250 running feet of *Cassia siamea* line in it.

(iii) There are usually about 30 such plots per coupe or in other words about 20 lb. of seed per coupe is needed.

It is also to be noted that rab plots four and five years old in some districts are now yielding quite a fair quantity of fertile seed. All sources of seed within a district should be made full use of before indenting on other districts.

37. *Sorting seed according to size—Teak.*—Previous years' experiments were repeated both for germination and planting out tests and results are confirmed.

Seed was selected in the following four groups, (A) district random sample, (B) selected biggest seed, (C) selected medium seed and (D) selected smallest seed.

Results were as follows :—

Locality.	Year.	Average germination percentage of 1,000 seed in 10 tests of 100 each.			
		District sample.	Selected biggest.	Selected medium.	Selected smallest.
Topslip Experimental—Garden Experiment 140	1936	49	39	37	33
Begur Experimental—Garden Experiment 67	1936	30	40	37	18
Average of 1936 experiments		40	40	37	26
Average of 1935 experiments		53	63	55	38
Do. 1934 do.		44	49	49	30
Do. 1933 do.		41	36	..	24
Average of 1933, 1934, 1935 and 1936 experiments		45	47	47	30

38. Two short-term planting out tests were observed and both experiments showed no appreciable difference in survival percentage or in mean height between the various types of seed. These experiments were Begur Experimental Garden Experiment 25 started in 1934 in which the seed was directly dibbled and Topslip Experimental Garden Experiment 128 in which the crop was raised in 1936 by stump planting the plants resulting from the germination tests of experiment No. 109 of 1935.

Thus the sorting out and rejection of teak seed on account of size appears to be an unjustified expense.

(For full experimental data see paragraph 277.)

39. *Size, age and condition of seed bearers—Teak.*—Seed was collected separately from large overmature trees (13′ to 15′ girth) middle sized trees approaching maturity (4½′ to 6′ girth) and small immature trees (below 3′ girth). The seed was collected from 10 trees of each class at each centre.

Each germination test of each class at each centre consisted of five sets of 100 seeds. Germination results were as follows :—

Locality.	Germination percentage of seed from		
	Overmature.	Mature.	Undermature.
Begur	37	27	21
Average of 1935 experiments	35	35	32
Average of 1935 and 1936 experiments ..	36	31	27
Average survivals percentage of 10 short-term planting out tests by dibbling and transplanting done in 1933 and 1934.	73	72	75

40. The above figures afford strong evidence that so far as germination and early development is concerned seed from both overmature and undermature teak trees is just as good as that from mature trees provided of course that the tree is old enough to produce fertile seed. In order to test whether this holds good in the later development of the plants three large scale long-term planting out experiments were started during the year at Begur, Dhoni and Topslip. The abbreviated results of these experiments at the end of the first year are as follows :—

Experiment.	Survival percentage.			Mean height in inches.		
	Over-mature.	Mature.	Under-mature.	Over-mature.	Mature.	Under-mature.
Wynaad experimental plot 29	95	94	93	12·90	15·80	15·90
Dhoni experimental—garden 101	93	95	95	34·30	34·60	42·40
Topslip experimental—garden 130	86	86	79	16·83	17·78	15·80
Average ..	91	92	89	21·34	22·73	24·70

NOTE.—The latter two experimental garden experiments having been successfully established are being converted into experimental plots.

(For full experimental data see paragraph 278.)

41. *Dalbergia latifolia.*—Similar germination tests were done at Begur with this species with 10 sets of 100 seeds each.

Results were—

Locality.	Germination per cent of seed collected from		
	Overmature.	Mature.	Undermature.
Begur experimental garden—Experiment 69	30	29	33
Average of 1935 experiments	25	34	29
Average of 1935 and 1936 experiments ..	28	32	31
Average survival percentage of 6 short-term planting out tests by dibbling and transplanting done in 1933 and 1934	72	73	70

42. For *Dalbergia latifolia* there are thus strong similar indications as for teak and in order to test whether these indications hold good in the later development of the plants two large scale long-term planting out experiments were started during the year at Dhoni and Topslip. The abbreviated results at the end of the first year are as follows :—

Experiment.	Survival percentage.			Mean height in inches.		
	Over-mature.	Mature.	Under-mature.	Over-mature.	Mature.	Under-mature.
Dhoni experimental garden—103	95	96	94	16·38	13·56	17·58
Topslip experimental garden—132	48	56	82	10·38	11·08	11·16
Average ..	72	76	88	13·38	12·32	14·37

NOTE.—These two experimental garden experiments having been successfully established are being converted into experimental plots.

(For full experimental data see paragraph 279.)

43. *Pterocarpus marsupium.*—Similar germination tests were done at Begur with *Pterocarpus marsupium*. Results were—

Locality.	Germination percentage of seed collected from		
	Overmature.	Mature.	Undermature.
Begur experimental garden—Experiment 71	52	48	35
Average of 1935 experiments	59	74	64
Average of 1935 and 1936 experiments. ..	56	61	50

44. During the year three large scale long-term planting out experiments were started at Begur, Dhoni and Tonslip is determine whether the condition of the seed bearers has any effect in development of the resulting trees.

Abbreviated results at the end of the first year are—

Experiment.	Survival percentage.			Mean height in inches.		
	Over-mature.	Mature.	Under-mature.	Over-mature.	Mature.	Under-mature.
Wynaad experimental—Plot 31	100	99	98	17·80	16·50	16·20
Dhoni experimental garden—Experiment 102	86	88	86	25·25	24·20	17·50
Topslip experimental garden—Experiment 131	31	69	34	8·78	12·97	12·60
Average ..	72	85	73	17·28	17·89	15·43

NOTE.—The latter two experimental garden experiments having been successfully established are being converted into experimental plots.

(For full experimental data see paragraph 280.)

45. *Terminalia crenulata.*—One set of ten germination tests were done with this species in this subject at Begur.

Results were—

Locality.	Germination percentage of seed collected from		
	Overmature.	Mature.	Undermature.
Begur experimental garden—Experiment 70	42	44	48
Average of 1935 experiments	25	19	24
Average of 1935 and 1936 experiments ..	34	32	36
Average survival percentage of 5 short-term planting out tests by dibbling and transplanting done in 1933 and 1934	57	57	65

46. To test the further development of the plants from seed from these types of seed bearers two large scale long-term planting out experiments were started during the year at Begur and Dhoni. The abbreviated results at the end of the first year are as follows :—

Experiment.	Survival percentage.			Mean height in inches.		
	Over-mature.	Mature.	Under-mature.	Over-mature.	Mature.	Under-mature.
Wynaad experimental—Plot 30	87	100	94	26·40	24·00	24·10
Dhoni experimental garden—Experiment 104	96	97	91	51·20	51·80	50·00
Average ..	92	99	93	38·80	37·90	37·05

NOTE.—The latter experimental garden experiment having been successfully established is being converted into an experimental plot.

(For full experimental data see paragraph 281.)

47. *Seed origin—All-India teak seed origin plots.*—We have now two well-established long-term plots (Experimental plot 129, Nilambur division and Experimental plot 59, South Coimbatore division) each three years old. The Nilambur plot has six origins, Nilambur, Anamalais, Travancore, South Bombay, South Burma and North Burma and consists of 10·2 acres in 24 randomised blocks each block containing approximately 520 plants at 6′ × 6′ espacement and there are four blocks to each origin. All origins were nearly 100 per cent at the end of the third year and varied in mean height from 17·55′ to 21·32′.

The South Coimbatore plot has four origins, Nilambur, Anamalais, Mysore and South Burma and consists of 4·0 acres in 16 randomised blocks, four per origin. All origins were roughly 90 per cent at the end of the third year and the mean height varied from 12·95′ to 17·13′. The order of origins in these plots in height growth is given below. These plots will be measured each year until the time of the first thinning when permanent sample plots will be laid out in each origin.

After establishing the above plots, plants were available, so a short-term garden experiment was carried out—Topslip Experimental Garden Experiment No. 106 with four origins.

The following table shows the order of origins in mean height growth expressed as percentages of the best origin :—

Nilambur Experimental Plot No. 129. Three years old.		South Coimbatore Experimental Plot No. 59. Three years old.		Topslip Experimental Garden No. 106. Two years old.	
South Bombay	100	Mount Stuart	100	Mysore	100
South Burma	98	Mysore	100	Mount Stuart	98
Travancore	93	Nilambur	90	Nilambur	93
Anamalais	92	South Burma	75	South Burma	53
Nilambur	91				
North Burma	82				

The above table shows that there is comparatively little difference in mean height growth of the various origins with the exception of South Burma in both the South Coimbatore division plots.

(iv) NURSERY WORK.

48. *Effect of shade on germination, survival and growth in nursery beds.*—Previous years experiments were repeated at Emmanur with 20 species. Sowing however was done much earlier than usual (mid April) and owing to the intensity of the hot weather 17 out of the 20 species definitely preferred shade, *Acacia ferruginea* was indifferent to the conditions and *Prosopis juliflora* and *Soymida febrifuga* preferred the open beds.

This result however is not normal (vide last year's report, paragraph 37).

The species preferring shade were—

Acacia auriculiformis.
Acacia leucophlœa.
Acacia planifrons.
Acacia sundra.
Albizzia amara.
Albizzia lebbek.
Anacardium occidentale.
Cassia fistula.
Cassia marginata.
Cassia siamea.
Chloroxylon swietenia.
Dolichandrone crispa.
Holoptelea integrifolia.
Pithecolobium dulce.
Pterocarpus santalinus.
Santalum album.
Terminalia chebula.

(For full experimental data see paragraph 282.)

49. *Artocarpus hirsuta.*—This species suffers in the nursery from the very heavy rain of the south-west monsoon and later from the hot sun after the monsoon. Experiments were therefore done at Chandanathode firstly to try and increase the germination of the species and secondly to try and minimize losses at a later stage.

The effect of shade on germination was tried by four treatments (A) the open control beds, (B) side shades of woven reed 18″ high, (C) complete top shade 2′ from the ground, (D) top and side shade (B and C combined).

The effect of shading in any form was slightly but definitely beneficial, complete top shading giving the best results as is seen from the germination percentages (A) 24 per cent, (B) 28 per cent, (C) 32 per cent, (D) 30 per cent.

50. The experiment was further extended for *Hopea parviflora* and *Cedrela toona* by trying the effect of three kinds of shading during the hot weather on the mortality and development of seedlings. The three treatments were (A) control, open; (B) 50 per cent top shade 3′ from the ground and (C) 100 per cent top shade at 3′ from the ground. The arrangement was that of a latin square, there being eight replications in each of three repetitions of each treatment.

Results show that shade is slightly beneficial in both saving of mortality and increase in growth for both these species but the mortality was not really serious even in the case of open beds.

Treatments were applied from mid-November 1936 to late May 1937.

Treatment.	*Hopea parviflora.*		*Cedrela toona.*	
	Mortality. PER CENT.	Height increment.	Mortality. PER CENT.	Height increment.
(A) Open	21	2·62″	23	5·54″
(B) 50 per cent shade ..	8	2·42″	15	6·79″
(C) 100 per cent shade ..	9	2·78″	6	9·25″

The experiment was started *after* germination was complete and the figures therefore show the effect of shading on survivals only and not on germination.

51. *Nursery watering experiment.*—An experiment was done at Emmanur experimental garden nursery to endeavour to determine the amount and periodicity of watering necessary in a nursery to give the best results in germination and survivals. Three species were experimented with, *Albizzia amara*, *Azadirachta indica* and *Prosopis juliflora* and three treatments tried. (A) Beds watered daily with 10 gallons of water, (B) beds watered on alternate days with 10 gallons of water and (C) beds watered on alternate days with 5 gallons of water. The " bed " referred to is a standard nursery bed 40′ × 4′.

Results are—

Species.	Treatment.	(A) Ten gallons daily.	(B) Ten gallons on alternate days.	(C) Fives gallons on alternate days.
Albizza amara ..	Germination per cent ..	24	22	23
	Mean height in inches in February 1937.	5·02″	5·50″	4·60″
Azadirachta indica.	Germination per cent ..	25	17	47
	Mean height in inches in February 1937.	25·18″	14·38″	10·66″
Prosopis juliflora ..	Germination per cent ..	11	12	14
	Mean height in inches in February 1937.	25·73″	16·83″	15·74″

The figures show that watering should be light till germination is over and should then be increased to give increased height growth. It is to be noted that the effect of water on *Albizzia amara* is very slight indeed.

52. *Effect of repeatedly using the same nursery beds—Teak.*—A set of experiments has been started in four centres to determine

the effect of repeatedly using the same nursery beds for the production of teak stumps and also to see whether the fertility of the beds can be kept up by artificial manure or green-manure crops.

In each experiment there are 16 standard beds each 40′ × 4′ which are allotted to four treatments on the basis of their outturn of the best size of stumps in the first year. The treatments are (A) beds sown each year—no manuring, (B) beds to be left fallow in alternate years; (C) a green-manure crop to be grown in the beds and dug in, in alternate years and (D) beds to be sown each year but manured with wood-ash and leaf mould.

The experiment at Nilambur was started in 1935 and those at Begur, Dhoni and Topslip in 1936.

53. At the end of the first year the average outturn of stumps per standard 40′ × 4′ bed sown with 40 lb. of seed was as follows :—

Date and centre.	Number of usable stumps 0·3″ to 0·8″	Average diameter of usable stumps.	Percentage of stumps usable.	Number of unusable stumps less than 0·3″ diameter.
			PER CENT.	
April 1936 Nilambur	1,353	0·43″	34	2,675
April 1937 Begur	2,405	0·41″	40	3,533
April 1937 Dhoni	1,847	0·39″	51	1,820
April 1937 Topslip	1,145	0·46″	42	1,565
Average ..	1,688	0·42″	42	2,398

The above average figures representing the sowing of 2,560 lb. of seed in 64 standard nursery beds (40′ × 4′) in four different places give an idea of the general production of stumps in current nursery practice. It is to be noted that each bed produces enough stumps of the best size to plant up one acre of plantation at 6′ × 6′ espacement and still leaves a reserve for casualty replacement. *It is particularly to be noted that at the end of one year only 42 per cent of the stumps produced are of the best size.*

54. The Nilambur experiment has reached the end of its second year. The average number of 0·3″ to 0·8″ diameter stumps per bed produced in treatment (A) in the second year was 2,456 (average diameter 0·43″) and in treatment, (D) 2,593 (average diameter 0·42″). The effect of the wood-ash and leaf mould in treatment, (D) has thus apparently been to increase the production of good stumps by 5 per cent. It is of interest that in this experiment the same beds sown with the same quantity of seed have produced 80 per cent more stumps of the best size in the second year than they did in the first year—

Nilambur division experimental plot 136.

Wynaad division experimental plot 34.

Palghat division experimental plot 152.

South Coimbatore division experimental plot 68.

55. *Nursery methods for the production of teak stumps.*—The work of 1933 and 1934 (reported in the 1934–1935 annual report paragraphs 36 to 40) compared, (A) dense sowing of about 80 lb. of

seed per 40′ × 4′ nursery bed, (B) transplanting very small seedlings at 4″ × 4″, (C) notching germinating seed at 4″ × 4″ and (D) sowing soaked seed at 3″ × 1½″ (about 15 lb. of seed per 40′ × 4′ bed). The results of this work showed that dense sowing gave much the greater number of usable stumps (over 0·3″ diameter) but was wasteful of seed. The next best treatment was sowing seed at 3″ × 1½″, i.e., a very light sowing but this tended to give poorly stocked beds although it gave the greatest economy of seed.

56. During 1935, three experiments were done at Dhoni, Topslip and Begur and four treatments used : (A) sowing seed at the rate of 60 lb. per 40′ × 4′ bed, (B) sowing seed at 60 lb. per standard bed and pricking out seedlings into (E) beds at 3″ × 3″ leaving the original (B) beds spaced 4″ × 4″. (C) sowing seed at 40 lb. per standard bed and (D) sowing seed at 20 lb. per bed. Each treatment consisted of four sub-beds 10′ × 4′, the arrangement being randomized. In mid-April 1936, the outturn of stumps per treatment was enumerated as (i) unusable stumps under 0.3″ diameter and (ii) usable stumps over 0·3″ diameter and gave the following results averaged for the three centres.

Data for a standard 40′ × 4′ nursery bed (average of three experiments at three centres).

—	Treatment.				
	(A)	(B)	(C)	(D)	(E)
Average number of usable stumps 0·3″ to 0·8″ diameter.	1,815	1,124	1,573	1,553	7,491*
Average number of unusable stumps less than 0·3″ diameter.	3,031	670	2,687	1,550	1,635†
Average diameter of the usable stumps ..	0·44″	0·44″	0·43″	0·44″	0·43″

* In eight standard beds or 936 per bed. † In eight standard beds or 204 per bed.

57. These experiments have been repeated this year and have given the following results :—

Data for a standard 40′ × 4′ nursery bed.

Locality.	Number of usable stumps per treatment.				
	(A)	(B)	(C)	(D)	(E)
Begur	1,746	772	1,849	1,503	2,322
Dhoni	2,649	1,432	1,532	2,205	7,774
Topslip	1,965	1,004	2,114	2,037	2,788
Average ..	2,120	1,069	1,832	1,915	4,295*
Average number of usable stumps below 0·3″ diameter.	3,333	277	2,536	1,268	869†

* In 6 standard beds or 716 per bed.
† In 6 standard beds or 145 per bed.

Average diameter of usable stumps per treatment (in inches).

Begur	0·44	0·49	0·43	0·45	0·42
Dhoni	0·42	0·43	0·39	0·47	0·47
Topslip	0·40	0·45	0·42	0·43	0·41
Average ..	0·42	0·46	0·41	0·45	0·44

58. Thus (i) the average diameter of usable stumps produced was practically the same with all treatments. (ii) In treatments (A), (C) and (D) (sowing with 60, 40 and 20 lb. of seed per bed)

the average number of usable stumps produced was greatest for A, but not very different from C and D. The quantity of seed used in A and C was out of all proportion to the number of good stumps produced. (iii) Treatment B in which after dense sowing, seedlings were pricked out into E beds showed the poorest outturn in the original beds. A large number of seedlings were pricked out into six E beds in each experiment. Although these E beds produced a fair number of seedlings of the right size they were in general badly grown with bushy root systems and some 60 per cent were not fit to be made into stumps on this account. Further the cost of the extra beds and the labour of pricking out was great and was not justified by the results.

59. The indication is therefore that the best procedure is to sow evenly about 20 to 30 lb. of seed per standard bed and do no pricking out of seedlings at all. This is most economical in both cost and quantity of seed.

This one bed sown with 20 lb. of seed produces enough good stumps of usable size to plant 1 acre at 6′ × 6′.—The plants that are too small in the first year can be left to the second year and there is also a certain amount of seed that has lain dormant in the first year that will germinate in the second year.

The results of these experiments thus substantively confirm the work which has previously been done in this subject—

Begur experimental garden experiment 59.
Dhoni experimental garden experiment 118.
Topslip experimental garden experiment 139.

60. *Experiments on attempting to produce usable stumps in the second year from undersized plants of the first year—Teak.*—It has been repeatedly pointed out that in current nursery work, at the end of the first year more than 50 per cent of the plants produced are not big enough to make stumps of a really suitable size (0·3″ to 0·8″ diameter). It has also been demonstrated (vide last year's annual report, paragraph 45) that leaving a nursery bed untouched for two years does not increase materially the number of good stumps produced because by such treatment the undersized plants merely disappear.

It has been suggested that at the end of the first year the bigger plants should be pulled out and stumped and the remainder left to grow for the second year. This remainder is also greatly aided by germination of dormant seed in the second year. This is current practice in some divisions and has been very successful.

Other divisions have raised objection to this practice and state that the complete nursery bed must be pulled to pieces at the time of planting. In consequence a further suggestion was made that when such a bed is completely dug up the undersized plants should be put back and allowed to grow for the second year.

61. Experiments were done during the year at three centres to demonstrate the practicability of this suggestion. At Begur, Dhoni and Topslip when the nursery beds were dug up, at each

centre 1,000 very undersized plants were selected and put back into nursery beds at an espacement of 4″ × 4″, 500 of them as stumps and 500 as transplants.

The outturn of these plants at the end of the second year is as follows :—

(i) *Plants put back as transplants.*

Centre.	Number of transplants put in.	Number of usable stumps produced.	Average diameter of usable stumps.	Percentage of plants that produced usable stumps.
			PERCENT	PERCENT
Begur	500	147	0·54″	30
Dhoni	500	376	0·51″	75
Topslip	500	191	0·51″	38
Average ..	500	238	0·52″	48

(ii) *Plants put back as stumps.*

Centre.	Number of stumps put in.	Number of usable stumps produced.	Average diameter of usable stumps.	Percentage of plants that produced usable stump.
			PERCENT.	PERCENT.
Begur	500	273	0.50″	55
Dhoni	500	446	0.53″	89
Topslip	500	253	0·45″	51
Average ..	500	324	0·49″	65

62. These usable stumps obtained from material normally wasted have been this year planted out to compare them with normal fresh and full sized one year old stumps and at present by their sprouting show themselves to be in no way inferior to fresh stumps. Even the plants which have thus been stumped for the second time in two years have produced normal sprouting.

The above figures show that if undersized plants are to be put back in the nursery for a second year they should be put back as stumps and not as transplants. If this is done instead of wasting some 50 per cent of material at the end of the first year only 17 per cent is eventually wasted.

These preliminary results need confirmation by repetition.

It is of course to be noted that in years when seed and stumps are both plentiful it is probably best to throw away the undersized stumps but these experiments show that in years of shortage a great deal of unusable material can be easily made usable.

(v) Artificial Regeneration.

(a) *Mixed deciduous timber forests.*

63. *Development of artificial regeneration in gaps.*—Gap regeneration in this type of forest is being fairly extensively practised. The idea underlying this method of regeneration is that such gaps can be left to themselves after they have been regenerated and intensively tended for two years. Whether this is really the case is not known and in consequence in September 1935, two experiments (Experimental plot 64, South Coimbatore division

and Experimental plot 28, Wynaad division) were started in which 10 to 15 typical gaps of 1933, regenerated with teak and tended by the districts concerned were taken over and enumerated. No tending at all is being done and their development and ultimate fate is being observed.

Each gap is approximately 30′ × 30′ thus containing roughly 25 plants at 6′ × 6′ espacement if fully stocked. Each gap will be successful if ultimately one good tree in it comes to maturity and therefore the best tree per gap is considered. The average heights of the best tree in each gap were as follows :—

Wynaad Division—		
January 1936 at 3 years old	12·07′	increment. 4·64′
January 1937 at 4 years old	16·71′	
South Coimbatore Division—		
January 1936 at 3 years old	3·06′	increment. 0·10′
January 1937 at 4 years old	3·16′	

It is thus seen that the Wynaad gaps are progressing slowly but that the South Coimbatore gaps have scarcely moved at all towards establishing themselves.

64. *Comparison of direct sowing, entire transplanting and stump planting—Teak.*—No experiments were done with teak during the year as it was considered that the superiority of stump planting over direct sowing and entire transplanting as a method of regenerating this species had been sufficiently well demonstrated during the last five years.

65. *Dalbergia latifolia.*—An experiment at Kannoth was done during the year with rosewood and confirmed previous years' results that stump planting is the best of the three methods of regeneration for this species.

The result of this experiment is given below and in addition for comparison the results of the previous three years are also shown :—

Year.	Average survival percentage.			Average mean height growth in inches.			Remarks.
	Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.	
1936	25	97	95	6·1	7·9	8·5	
1935	54	63	68	7·7	8·3	10·2	Four experiments at 4 centres averaged.
1934	58	58	89	6·8	6·2	15·6	Three experiments at 3 centres averaged.
1933	77	68	97	11·2	7·5	15·5	Do.
Average of 1933, 1934, 1935, 1936,	54	69	87	8·0	7·7	12·5	Average of 10 experiments over 4 years at 4 centres.

(For full experimental data, see paragraph 283.)

66. *Pterocarpus marsupium*.—An experiment was done at Kannoth during the year and again confirmed the results of previous years' work that of the three methods tried, stump-planting is easily the most successful method of regenerating *Pterocarpus marsupium*.

67. The results of this experiment is given below together with the results of the previous three years for comparison.

Year.	Average survival percentage.			Average mean height growth in inches.			Remarks.
	Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.	
1936	62	77	95	4·3	12·4	10·6	
1935	59	65	79	7·7	5·8	10·3	Four results at 4 centres averaged.
1934	68	82	90	10·1	7·3	16·2	Three results at 3 centres averaged.
1933	86	82	79	14·2	10·9	19·5	Do.
Average of 1933, 1934, 1935 & 1936.	69	77	86	9·1	9·1	14·2	Average of 11 experiments over 4 years at 4 centres.

(For full experimental data, see paragraph 284.)

68. *Pterocarpus dalbergioides* (*Andaman Padauk*).—An experiment with this species was done at Kannoth. Sowing was almost a complete failure and stump-planting very poor indeed while transplanting gave very fair results as is seen from the table below—

Last year's results are included for comparison.

	Survival percentage.			Mean height in inches.		
	Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
1936	6	54	16	6·5	24·3	11·8
1935	..	59	2	..	14·0	6·5
Average of 1935 & 1936.	3	57	9	3·3	19·2	9·2

(For full experimental data, see paragraph 284-A.)

69. A further experiment No. 34 was done with this species also at Kannoth in a ponam crop of hill paddy in which the results from transplants, (A) 14″, (B) 28″, (C) 42″ and ,(D) 57″ high were compared. As is seen from the table below which gives the results in January 1937 the two largest sizes of transplants have done the best.

Treatment.	Survival percentage	Mean height in inches.
A 14″ transplants	53	17·60
B 28″ Do.	78	32·00
C 42″ Do.	96	45·06
D 57″ Do.	98	57·80

70. *Terminalia crenulata*.—Four experiments with *Terminalia crenulata* were done at four centres. Three of these experiments

confirmed previous years' results that stump-planting is the best method for the species and in one experiment (at Topslip) transplanting showed the best results.

The averaged results of these four experiments are shown below together with the results of the previous three years for comparison :—

Year.	Average survival percentage. Sowing.	Transplanting.	Stumping.	Average mean height growth in inches. Sowing.	Transplanting.	Stumping.	Remarks.
1936	48	53	71	21·0	18·8	26·2	Four results at 4 centres averaged.
1935	35	64	50	13·8	13·8	22·3	Do.
1934	36	56	86	16·4	13·0	27·7	Three results at 3 centres averaged.
1933	65	86	75	20·7	20·5	29·7	Do.
Average of 1933, 1934, 1935, 1936.	46	65	70	18·0	16·5	26·5	Average of 14 experiments at 4 centres over 4 years.

(For full experimental data, see paragraph 285.)

71. *Xylia xylocarpa*.—No new experiments were done with this species. The averaged results of the work of the previous three years are given below for comparison. Direct sowing is the best of the three methods of regeneration for *Xylia xylocarpa*.

Year.	Average survival percentage. Sowing.	Transplanting.	Stumping.	Average mean height growth in inches. Sowing.	Transplanting.	Stumping.	Remarks.
1935 ..	81	50	14	6·0	4·1	2·4	Two results at 2 centres averaged.
1934 ..	72	16	53	6·6	4·2	4·1	Three results at 3 centres averaged.
1933 ..	78	69	89	7·0	4·2	4·8	Do.
Average of 1933, 1934, 1935.	77	45	52	6·5	4·2	3·8	Average of 8 experiments at 3 centres over 3 years.

72. *Artocarpus hirsuta*.—An experiment was done with this species at Kannoth after clear-felling and burning mixed deciduous forest.

Results are given below together with those of 1934 and 1935 for comparison :—

Year.	Average survival percentage. Sowing.	Transplanting.	Stumping.	Mean height growth in inches. Sowing.	Transplanting.	Stumping.
1936	99	45	83	8·3	5·3	5·7
1935	54	26	82	5·6	6·5	6·4
1934	12	2	33	11·2	12·0	14·9
Average 1934, 1935, 1936.	55	24	66	8·4	9·3	10·6

(For full experimental data, see paragraph 286.)

73. *Swietenia macrophylla.*—As previous years' work had shown that this species only stumps very poorly, this year's work was confined to comparing direct sowing with transplanting of various sizes of transplants.

Four experiments were done during the year and in addition three experiments of 1935 and one experiment of 1934 were remeasured.

In all four of the 1936 experiments sowing was found to be as good as the results of the best size of transplants and better than the poorer sizes in survival percentage. These excellent results by the direct sowing of Mahogany are however abnormal and must be regarded with caution. It was a poor seed year for the species but the seed appears to have been of very good quality.

74. Comparing sowing and transplanting average results are only given for survival percentage as the height growth of transplants largely depends on their initial size.

Year.	Average survival percentage.			Remarks.
	Sowing.	Transplanting.	Stump planting.	
1936	86	59	Not done.	Four experiments at 4 centres averaged.
1935	49	60	Do.	Do.
1934	38	63	8	Two experiments at 2 centres averaged.
Average of 1934, 1935 and 1936.	58	61	8	Average of 10 experiments at 4 centres over 3 years.

75. Comparing the results of using different sizes of transplants from 3″ to 48″ high it appears that transplants from 18″ to 36″ high do best as far as survival percentage is concerned but their growth shows that they feel the shock of transplanting far more than do the smaller sizes of transplants. The larger sizes of transplants appear to be more susceptible to attacks by both the shoot and collar borers and this is particularly so under evergreen cover. Height increment after the first year is very much the same for all sizes of transplants.

(For full experimental data, see paragraph 287.)

76. *Pre-monsoon stump-planting—General.*—1936 was the third abnormal year in succession. It had an unusually hot hot-weather with a lack of pre-monsoon showers but the south-west monsoon arrived ten days to a fortnight earlier than usual and broke at the end of May.

Results were therefore somewhat abnormal. In places having a true West Coast type of climate the best date of planting moved forward about a fortnight to April 1st, but owing to the comparative failure of April and early May planting at Walayar and Topslip (which are out of the true West Coast climate) the general best date of planting was May 15th. This shows the weakness of averaging results for all centres and in consequence in paragraphs 81 to 84 are given the results for each centre separately where we have now completed five years experimental work. We have now

got past the period of proving the general principle of early planting and for the best date of planting each centre must be separately considered on its own merits.

77. The following table shows the general result of this year's experiments :—

Species.	Best date of stump-planting.	Average survival percentage.	Average mean height growth in inches.	Survival per cent best date/Survival per cent 1st June.	Mean height best date/Mean height 1st June.
Teak	15th May ..	97	23·6	1·1	1·6
Dalbergia latifolia ..	Do.	94	12·3	1·0	1·2
Pterocarpus marsupium	Do.	92	18·3	1·0	1·2
Terminalia crenulata	Do.	93	32·1	1·1	1·3
Artocarpus hirsuta ..	Late May ..	75	5·3	1·0	1·2

(For weather conditions see rainfall statement in paragraph 274.)

It should be noted that all experiments at Kannoth were done in a ponam crop of hill paddy.

78. *Teak.*—Five experiments were done at five centres. Abbreviated data are as follows :—

Percentage survivals after one season.

Experimental garden.	Experiment number.	Year of formation.	1st April 1936.	15th April 1936.	1st May 1936.	15th May 1936.	1st June 1936.
Dhoni	106	1936	93	74	85	99	92
Topslip	122	,,	42	6	49	96	89
Walayar	4	,,	70	53	69	93	67
Begur	60	,,	97	100	100	99	95
Kannoth	22	,,	85	93	96	96	96
		Average ..	77	65	80	97	88

Mean height growth after one season (in inches).

Experimental garden.	Experiment number.	Year of formation.	1st April 1936.	15th April 1936.	1st May 1936.	15th May 1936.	1st June 1936.
Dhoni	106	1936	33·5	22·6	29·3	38·0	24·2
Topslip	122	,,	31·7	23·5	21·2	23·8	17·2
Walayar	4	,,	35·9	30·0	26·2	33·1	20·3
Begur	60	,,	22.3	17·7	16·8	13·4	9·7
Kannoth	22	,,	21·7	17·4	16·2	9·9	7·6
		Average ..	29·0	22·2	21·9	23·6	15·2

It is seen from the above tables that in places having a true West Coast type of climate (Kannoth, Begur and Dhoni) early April planting has again justified itself by its increased height growth. At Walayar, which is on the edge of the coast climatic conditions although early April planting has produced an increased height growth it has shown a slightly lower survival percentage. At Topslip which is out of the coast climate early April planting has definitely failed. Considering all five centres and survival percentage and mean height growth together we reach the conclusion that in 1936 May 15th planting has produced the best results (an average survival percentage of 97 and an average mean height growth at the end of the first growing season of 23·6").

79. Previous years' results are recapitulated :—

Year.	Number of experiments.	Best date.	Percentage of survivals.	Mean height growth in inches.	Proportion of height growth of best date to 1st June planting.	Rains.
1932	3	16th April.	100	43·3	2·0	Normal.
1933	3	1st April.	91	35·3	2·4	Do.
1934	5	16th April.	88	18·6	1·6	Abnormally dry.
1935	5	15th April.	73	19·9	1·9	Do.
1936	5	15th May.	97	23·6	1·6	Early monsoon.

As has already been noted, in 1936 the monsoon broke a fortnight earlier than is normal and in consequence the proportion of the height growth of the best date to that of June 1st planting (1·6) is not as large as usual.

80. Although the best date of planting in 1936 was one month later than in 1934 and 1935 which were abnormally dry years yet the stumps sprouted earlier as is seen from the following table :—

Date of observation.	Percentage of stumps sprouted in experiments at							
	Dhoni.	Topslip.	Walayar.	Begur.	Kannoth.	Average.	Average in 1934 experiments.	Average of 1935 experiments.
25th April 1935 ..	..	..	..	..	..	..	15	2
1st May 1935 ..	..	..	..	..	..	..	40	15
16th May 1935 ..	..	..	..	..	..	..	42	27
1st June 1935 ..	28	89	63	59	67	61	56	35
25th June 1935 ..	100	97	99	100	98	99	77	46
16th July 1935 ..	100	97	98	100	98	99	84	62
1st August 1935.	99	96	93	100	96	97	88	73
Final survivals ..	99	96	93	100	96	97	88	73

The above figures show that the result of early stump planting can be estimated in June, early in the month if the monsoon has been early and late in the month if the monsoon has been late.

(For full experimental data see paragraph 288.)

81. *Summary of five years work at Begur, Dhoni and Topslip.*—At these three centres we have now done these pre-monsoon stump planting experiments for five years. During the coming year they will be written up in pamphlet form for each centre separately giving full experimental data.

Below is given the abbreviated results of this five years work and the conclusions that may be drawn from them for each centre. It should be noted that of the five years in which the experiments have been done 1932 and 1933 were normal years climatically, 1934 and 1935 had abnormally hot hot-weathers with lack of pre-monsoon showers but normal monsoons, while 1936 had an abnormally hot hot-weather, and lack of pre-monsoon showers, but an abnormally early monsoon which broke at the end of May, about ten days earlier than usual. The figures therefore indicate the extreme risks of pre-monsoon planting on any date.

82. *Begur*—

Survival per cent of stumps planted on

Year of experiments.	15th March.	1st April.	15th April.	1st May.	15th May.	1st June.	15th June.
1936	..	97	100	100	99	95	..
1935	..	86	89	73	81	68	..
1934	12	22	92	..	..	..	..
1933	71	95	78	94	98	93	..
1932	..	..	100	100	99	91	87
Average ..	..	75	92	92	94	87	..

Year of experiment.	Mean height growth in inches of stumps planted on						
	15th March.	1st April.	15th April.	1st May.	15th May.	1st June.	15th June.
1936	..	22·3	17·7	16·8	13·4	9·7	..
1935	..	32·8	31·8	16·8	18·2	11·1	..
1934	10·2	11·0	11·6	..	..	..	..
1933	16·5	17·3	12·2	9·6	12·2	5·6	..
1932	..	..	55·6	48·1	49·4	29·8	20·6
Average ..	..	20·9	25·8	23·5	22·7	14·1	..

The above figures conclusively show that for Begur, April 15th is the best date for stump planting teak and that there is very little risk attached to such planting. The figures for five years show that planting on this date gives an *increase* of survival percentage and mean height of 5 per cent and 84 per cent, respectively, over normal 1st June planting. It is also to be noted that the poorest survival percentage of April 15th planting during the five years was 78 per cent while that of normal 1st June planting was 68 per cent.

83. *Dhoni*—

Year of experiment.	Survival per cent of stumps planted on						
	15th March.	1st April.	15th April.	1st May.	15th May.	1st June.	15th June.
1936	..	93	74	85	99	92	..
1935	..	81	93	90	96	74	..
1934	10	54	97	90	93	95	..
1933	80	79	94	82	93	92	..
1932	..	..	100	71	100	95	92
Average ..	..	77	92	84	96	90	..

Year of experiment.	Mean height growth in inches of stumps planted on						
	15th March	1st April.	15th April.	1st May.	15th May.	1st June.	15th June.
1936	..	33·5	22·6	29·3	38·0	24·2	..
1935	..	24·2	27·5	19·4	16·8	13·0	..
1934	15·0	18·8	17·8	9·3	11·3	10·6	..
1933	49·0	59·0	48·0	38·0	35·0	28·0	..
1932	..	..	38·5	30·2	26·8	13·8	13·3
Average ..	..	33·9	30·9	25·2	25·6	17·9	..

These figures conclusively show that for Dhoni (as for Begur), April 15th is the best date for stump planting teak and that there is very little risk attached to such planting. The figures for five years show that planting on this date gives an *increase* of survival percentage and mean height growth of 2 per cent and 73 per cent, respectively, over normal 1st June planting. It is also to be noted

that during the five years the poorest survival percentage of April 15th planting was the same as that for normal 1st June planting, namely, 74 per cent.

84. *Topslip*—

Year of experiment.	Survival percentage of stumps planted on 15th March.	1st April.	15th April.	1st May.	15th May.	1st June.	15th June.
1936	..	42	6	49	96	89	..
1935	..	55	56	56	29	39	..
1934	71	97	96	95	89	96	..
1933	87	99	86	95	90	82	..
1932	..	..	99	100	99	91	89
Average ..	..	73	69	79	81	79	..

Year of experiment.	Mean height growth in inches of stumps planted on. 15th March.	1st April.	15th April.	1st May.	15th May.	1st June.	15th June.
1936	..	31·7	23·5	21·2	23·8	17·2	..
1935	..	24·0	15·8	15·6	15·2	13·2	..
1934	34·3	29·5	36·6	30·0	18·6	18·5	..
1933	58·1	57·7	45·6	28·8	21·6	21·1	..
1932	..	..	35·8	33·5	32·7	21·7	17·0
Average ..	..	35·7	31·5	25·8	22·4	18·3	..

The above figures show that the *safest* date for stump planting teak at Topslip is May 1st. The *best* date is the first half of April but the risk is large as is shown by the 1936 figures.

The risk of planting on May 1st is not as great as that of planting normally on June 1st as is shown by the fact that the poorest survival percentage during the five years of May 1st planting is 49 per cent while that of June 1st planting is 39 per cent.

May 1st planting has given an increase of mean height growth of 42 per cent over normal June 1st planting. A much greater increase in height growth is obtained by planting earlier than May 1st but as stated above there is a risk of a low survival percentage.

Figures for the remaining two centres of Walayar and Kannoth are not given in a similar summary as experiments have only been done for three years so far.

85. *Pre-monsoon stump planting—Teak—District work.*—A number of districts did pre-monsoon stump planting of teak on a large scale. In the list below are given the results of some of this work. All district work is not included because for comparison with experimental work it is necessary that the planting of an area should have been done in the space of few days only and that a correct record of casualty replacement and the date on which it was done should have been kept. All districts did not do this and hence the list of early planted areas is incomplete.

District Forest Officers were asked to give their opinions on the normality or otherwise of the weather and all were agreed that last hot weather was hotter than normal with a lack of pre-monsoon showers and the south-west monsoon arrived about 10 days to a fortnight before the usual time.

The date of planting given is the middle of a period of a few days (usually up to a week) and the survival percentage is that obtained without any casualty replacement at all. The date of enumeration given is important as will be seen from the table of sprouting in paragraph 80.

In reading these figures it must be remembered that we do not know what would have been the result of normal monsoon (June 1st) planting with no casualty replacement at all except so far as it can be seen from the experimental figures in paragraph 78.

86. Results in areas comparable in climate with one or more of the experimental centres :—

District.	Range.	Date of planting.	Area in acres.	Survival per-centage.	Date of enumeration.
Nilambur ..	Nilambur ..	April 6th ..	8·7	74	27th June 1936.
		April 20th ..	7·9	64	Do.
		April 25th ..	68·2	79	Do.
	Amarampalam.	April 3rd ..	35·0	61	Do.
		April 19th ..	67·2	59	Do.
Mangalore, South	Kasaragod ..	May 13th ..	6 coupes.	93	1st June 1936.
	Puttur . ..	May 3rd ..	1 coupe.	87	Do.
	Uppinangadi..	April 28th ..	1 coupe.	30	20th June 1936.
Nilgiris	Mudumalai ..	April 7th ..	31·0	76	30th June 1936.
		June 1st ..	11·4	96	Do.
Palghat	Mannarghat ..	April 24th ..	11·0	54	5th June 1936 .
	Chindaki ..	April 11th ..	9·0	85	3rd June 1936.
	Dhoni ..	April 5th ..	9·0	68	11th June 1936.
		April 27th ..	20·0	62	Do.
	Elival ..	April 29th ..	15·0	68	4th June 1936.
	Walayar ..	May 3rd ..	25·0	93	3rd June 1936.
Wynaad	Begur	April 2nd ..	12·5	86	15th June 1936.
		April 4th ..	15·0	82	Do.
		April 17th ..	40·5	90	Do.
	Chedleth ..	April 5th ..	21·0	95	2nd July 1936.
		April 20th ..	54·0	85	Do.
	Kannoth ..	April 15th ..	3·0	76	30th June 1936.
		May 12th ..	17·0	96	Do.
Kollegal		May 15th ..	12·0	98	End of August.
South Coimbatore.	Topslip ..	April 12th ..	87·0	77	3rd July 1936.

87. Results in areas not comparable in climate with experimental centres :—

District.	Range.	Date. of planting.	Area in acres.	Survival per-centage.	Date of enumeration.
Palghat	Bolampatti ..	April 15th ..	4	21..	29th June 1936.
		May 1st ..	4·5	22	Do.
	Singampatti ..	April 18th ..	1·75	56	Do.
		May 1st ..	2·5	56	Do.

When the above figures of dates of planting and survival percentage are compared with those given in paragraph 78 it is seen that they agree to a surprising extent and this is a further confirmation of the value of small-scale experimental work.

The poor survival of planting on April 28th at Uppinangadi (30 per cent) is a mystery and no explanation for it has been found. The figures for Dhoni and Elival are lower than were to be expected (vide experimental results) and this is accounted for by small size nursery stock of poor quality.

In general there has been a tendency in district work to overdo pre-monsoon planting. For example, on the basis of the experimental work done so far, planting at Nilambur and Mudumalai in the first week of April and at Topslip in the second week of April would not be recommended unless there had been really good rain and the ground was thoroughly damp.

88. Pre-monsoon stump planting of *Dalbergia latifolia, Pterocarpus marsupium, Terminalia crenulata* and *Artocarpus hirsuta* gave the following results :—

Dalbergia latifolia.—Four experiments at four centres gave the following abbreviated results :—

Experimental garden.	Experiment number.	Percentage of survivals of stumps planted on 1st April 1936.	16th April 1936.	1st May 1936.	16th May 1936.	1st June 1936.
Dhoni ..	108	48	30	71	95	95
Topslip ..	124	72	57	36	91	89
Begur	61	95	94	87	97	95
Kannoth ..	23	94	80	26	94	94
	Average ..	77	65	55	94	93

Experimental garden.	Experiment number.	Mean height growth in inches after one season. 1st April 1936.	16th April 1936.	1st May 1936.	16th May 1936.	1st June 1936.
Dhoni ..	108	13·5	12·6	13·4	15·4	13·4
Topslip ..	124	11·4	9·9	10·2	12·8	10·0
Begur	61	10·1	11·2	11·5	9·9	9·0
Kannoth ..	23	11·0	10·7	10·0	11·1	9·9
	Average ..	11·5	11·1	11·3	12·3	10·6

It is thus seen that considering both height growth and survivals planting in mid-May has given the best results—an increase in survivals of one per cent and an increase in height growth of 16 per cent over normal early June stump planting.

It is to be noted that this best date is slightly later than that obtained in previous year's experiments (May 1st) and is accounted for by the abnormal year.

(For full experimental data see paragraph 289.)

89. *Pterocarpus marsupium.*—Four experiments at four centres gave the following abbreviated results :—

Experimental garden.	Experiment number.	Percentage of survivals of stumps planted on 1st April 1936.	15th April 1936.	1st May 1936.	15th May 1936.	1st June 1936.
Dhoni ..	107	92	69	75	100	92
Topslip ..	123	26	8	7	74	91
Begur ..	63	57	67	98	100	98
Kannoth ..	24	46	64	52	92	96
	Average ..	55	52	58	92	94

Mean height growth in inches after one season.

Experimental garden.	Experiment number.	1st April 1936.	15th April 1936.	1st May 1936.	15th May 1936.	1st June 1936.
Dhoni ..	107	35·2	28·5	29·6	38·0	30·6
Topslip ..	123	7·2	6·5	8·7	7·0	6·2
Begur ..	63	12·6	14·1	17·2	15·6	13·6
Kannoth ..	24	9·7	8·3	8·2	12·4	9·1
	Average ..	16·2	12·9	15·9	18·3	14·9

May 15th has given the best results when both height growth and survivals are considered.

The results of this date show an increase of 23 per cent in mean height growth over normal early June planting.

This is a much smaller increase than usual and is accounted for by the abnormal year.

(For full experimental data see paragraph 290.)

90. *Terminalia crenulata.*—Four experiments at four centres have given the following abbreviated results :—

Experimental garden.	Experiment number.	Percentage of survivals of stumps planted on 1st April 1936.	15th April 1936.	1st May 1936	15th May 1936.	1st June 1936.
Begur ..	62	81	96	85	99	89
Kannoth ..	25	78	88	84	94	88
Dhoni ..	110	21	96	34	96	68
Topslip ..	125	33	7	20	84	92
	Average ..	53	50	56	93	84

Mean height growth in inches after one season.

Begur ..	62	32·2	31·5	28·5	26·5	17·1
Kannoth ..	25	27·6	24·8	24·9	19·8	18·1
Dhoni ..	110	49·1	45.8	42·6	51·9	35·1
Topslip ..	123	38·5	26·1	32·2	30·2	28·0
	Average ..	36·9	32·1	32·1	32·1 ..	24·6

Thus it is seen that in 1936, May 15th was the best date for stump planting *Terminalia crenulata.* Planting on this date gave an increase in survival percentage of 9 and an increase in mean height growth of 30 per cent over normal 1st June planting.

(For full experimental data see paragraph 291.)

91. *Artocarpus hirsuta.*—Four experiments were done at four centres and gave the following abbreviated results :—

Experimental garden.	Experiment number.	Percentage of survivals of stumps planted on 5th April 1936.	1st May 1936.	15th May 1936.	1st June 1936.	15th June 1936.	1st July 1936.
Begur ..	64	..	78	94	88	98	86
Kannoth ..	26	10	22	90	90	56	..
	109	..	5	77	89	82	66
Topslip ..	126	..	..	45	56	72	64
Average ..		10	26	77	81	78	72

Mean height growth in inches after one season.

Begur ..	64	..	8·4	8·2	6·5	6·8	4·7
Kannoth ..	26	8·6	5·6	7·6	7·5	4·9	..
Dhoni ..	109	..	7·6	15·0	14·7	9·9	9·0
Topslip ..	126	..	0	4·6	4·5	3·7	3·3
Average ..		8·6	5·4	8·9	8·3	6·3	4·3

As is seen from the above tables early planting of this species is poor and taken in conjunction with previous years' results the indication is that planting should not be done until late May. If planted earlier than this although increased height growth is often obtained the danger of poor stocking is great.

(For full experimental data see paragraph 292.)

92. *Stump planting—Effect of age and diameter of stumps—Teak.*—Three experiments were done in three centres in continuation of the work of previous years. Considering both survival percentage and mean height growth, the work done so far shows that

stumps do best if within the diameter range of 0·4″ to 0·8″. Three year old stumps have not done well but within the diameter range mentioned it does not appear to matter whether the stumps are one or two years old.

The falling off of survival percentage and mean height growth of stumps below this range of size is much more marked than that of stumps above this range, except in the case of 3-year old stumps.

Abbreviated results are as follows :—

Survival percentage after one season.

Locality.	Age of stumps.	Diameter of stumps in inches. 0·3/0·4	0·4/0·5	0·5/0·6	0.6/0·7	0·7/0·8	0·9/1·0	1·0/1·1	1·2/1·4	1·8/2·0
Dhoni ..	One year ..	94	..	95	..	92	..	..	..	..
	Two years ..	..	..	96	..	93	93	..	..	..
Topslip ..	One year ..	22	23	36	33	..	..	..	..	..
	Two years ..	..	42	44	51	58	..	..	..	..
Begur ..	One year ..	95	..	98	..	97	..	98	..	..
	Two years ..	..	..	..	..	98	..	99	98	..
	Three years ..	..	..	..	..	..	..	..	..	87

Mean height growth in inches after one season.

Locality.	Age of stumps.	0·3/0·4	0·4/0·5	0·5/0·6	0.6/0·7	0·7/0·8	0·9/1·0	1·0/1·1	1·2/1·4	1·8/2·0
Dhoni ..	One year ..	24·4	..	28·1	..	27·1	..	..	..	..
	Two years ..	..	..	29·0	..	25·7	25·1	..	..	..
Topslip ..	One year ..	23·9	23·6	22·9	28·6	..	..	..	..	..
	Two years ..	..	19·7	21·1	21·9	24.6	..	..	..	..
Begur ..	One year ..	13·1	..	17·0	..	16·4	.	18·0	..	..
	Two years ..	..	..	..	..	18·8	..	18·8	18·8	..
	Three years ..	..	..	..	..	..	..	..	..	0·6

(For full experimental data, see paragraph 293.)

93. *Dalbergia latifolia.*—Experiments were done at Begur, Dhoni and Topslip with this species. One and two-year old stumps were used within a range of diameter of stumps from 0·1″ to 0·8″. Results show that 2-year old stumps do better than 1-year old stumps and that the best range of diameter is from 0·2″ to 0·6″. Stumps over this diameter although showing good height growth tend to result in a smaller survival percentage.

Abbreviated results are as follows :—

Survival percentage after one season.

Locality.	Age of stumps.	Diameter of stumps in inches. 0·1/0·2	0·2/0·3	0·3/0·4	0·4/0·5	0·5/0·6	0·6/07	0·7/0·8
Begur ..	One year ..	96	94	88	..	..	..	..
	Two years ..	..	98	96	94	88	82	..
Dhoni ..	One year ..	97	98	95	..	..	..	..
	Two years ..	..	..	100	..	92	..	90
Topslip ..	One year ..	88	83	..	..	..	..	..
	Two years ..	..	89	52	..	..	..	..

Mean height growth in inches after one season.

Locality.	Age of stumps.	0·1/0·2	0·2/0·3	0·3/0·4	0·4/0·5	0·5/0·6	0·6/07	0·7/0·8
Begur ..	One year ..	9·5	12.1	11.6	..	..	..	..
	Two years ..	..	12·7	14·1	14·6	15·8	15·8	..
Dhoni ..	One year ..	11·9	15·4	14·6	..	..	..	..
	Two years ..	..	..	14·8	..	17·8	..	18·0
Topslip ..	One year ..	11·8	11·9	..	..	..	..	..
	Two years ..	..	10·0	12·2	..	..	..	..

(For full experimental data see paragraph 294.)

94. *Pterocarpus marsupium.*—Three experiments were done at three centres. Results show that stumps from 0·3″ to 0·8″ diameter do best and that within this range it does not matter whether the stump is one year or two years old. Generally the older and bigger the stump the better the result. We do not appear to have reached the upper limit in size and there is no reason to suppose that stumps bigger than 0·8″ diameter will not do well.

Abbreviated results are—

Survival percentage after one season.

Locality.	Age of stumps.	Diameter of stumps in inches. 0·1/0·2	0·2/0·3	0·3/0·4	0·4/0·5	0·5/0·6	0·6/0·7	0·7/0·8
Begur ..	One year ..	86	72	98	100	100	94	..
	Two years ..	..	..	..	..	98	98	..
Dhoni ..	One year	..	..	94	..	96	..	98
	Two years ..	..	..	97	..	98	..	97
Topslip ..	One year ..	..	..	32	62	..	..	..
	Two years ..	..	..	36	56	..	..	..

Mean height growth in inches after one season.

Locality.	Age of stumps.	0·1/0·2	0·2/0·3	0·3/0·4	0·4/0·5	0·5/0·6	0·6/0·7	0·7/0·8
Begur ..	One year ..	12·7	16·4	17·7	20·7	22·9	21·7	..
	Two years ..	..	..	..	..	23·6	24·0	..
Dhoni ..	One year ..	..	..	34·3	..	40·5	..	42·1
	Two years ..	..	..	34·4	..	33·8	..	40·0
Topslip ..	One year ..	..	..	8·9	7·6	..	..	..
	Two years ..	..	..	7·7	7·5	..	..	..

(For full experimental data see paragraph 295.)

95. *Terminalia crenulata.*—Results with this species showed that stumps from 0·4″ to 0·8″ diameter do best and within this range there is little difference between 1-year and 2-years old stumps.

Smaller and larger diameters than this range gave poorer results either in survival per cent or in mean height growth or in both.

Abbreviated results are—

Survival percentage after one season.

Locality	Age stumps.	Diameter of stumps in inches. 0·3/0·4	0·5/06	0·7/0·8	0·9/1·0	1·0/1·1	1·2/1·4	1·4/1·6
Begur ..	One year ..	86	98	88	..	74	..	..
	Two years ..	..	..	78	..	44	38	16
Dhoni ..	One year ..	92	98	81	..	..	..	..
	Two years ..	..	93	84	52	..	..	..

Mean height growth in inches after one season.

Locality	Age stumps.	0·3/0·4	0·5/06	0·7/0·8	0·9/1·0	1·0/1·1	1·2/1·4	1·4/1·6
Begur ..	One year ..	29.3	28·4	25·7	..	22.5	..	..
	Two years ..	..	..	30·7	..	19.3	19.2	19·9
Dhoni ..	One year ..	42·0	49.4	46·6	..	..	..	..
	Two years ..	..	43·5	43·3	39.1	..	..	..

(For full experimental data see paragraph 296.)

96. *Artocarpus hirsuta.*—Experiments were done at Begur and Kannoth with this species. Stumps one, two and three-years old and from 0.1″ to 1·6″ diameter were used and results indicate that stumps below 0·2″ diameter give poor results. Above this size the older and bigger the stumps the better the results.

Abbreviated results are—

Survival percentage after one season.

Locality	Age of stumps.	Diameter of stumps in inches. 0·1/0·2	0.2/0·3	0·3/04	0·4/0·5	0·5/0·6	0·6/0·7	0.8/1·0	1·4/1·6
Begur ..	One year ..	..	84	92	94	..	..	..	..
	Two years..	..	..	92	90	86	88	88	..
	Three years.	..	..	..	..	..	..	..	70
Kannoth.	One year ..	8	56	94	..	..	..	..	..
	Two years..	..	60	64	80	..	..	..	..

Mean height growth in inches after one season.

Locality	Age of stumps.	0·1/0·2	0.2/0·3	0·3/04	0·4/0·5	0·5/0·6	0·6/0·7	0.8/1·0	1·4/1·6
Begur ..	One year	..	6·4	8·4	8·2	..	..	..	..
	Two years..	..	..	6·9	7·5	7·1	8·1	10·2	..
	Three years.	..	..	..	..	..	..	..	9.6
Kannoth.	One year ..	1·8	6·0	7·4	..	..	..	..	..
	Two year ..	..	3.3	5·9	5·6	..	..	..	..

(For full experimental data see paragraph 297.)

97. *Effect of age and diameter of stumps—Teak—District work.*—An interesting series of experiments was done by Wynaad division in three areas in this subject covering an area of 13 acres. Stumps were sorted before planting into undersized (below 0·4″ diameter) and correct size (0·4″ to 0·8″ diameter) and also into 1 and 2-year old stumps.

The effect of this sorting is seen by the figures of casualty replacement that had to be done which were as follows :—

Range.	Age of stumps.	Below 0·4″ diameter.	0·4″ to 0·8″ diameter
Kannoth Range	One year old	33%	14%
	Two years old	21%	15%
Begur Range	One year old	15%	11%
	Two years old	11%	11%
Chedleth Range	One year old	20%	16%

It is thus seen that if the stumps are of the best size 1 and 2-year old stumps give similar results and if the stumps are undersized the 2-year old stumps give better results than 1-year old stumps. In all cases the stumps of the correct size gave better results than the undersized stumps. The above district figures afford striking confirmation of experimental results.

98. *Stump-planting.—Teak—Effect of depth of planting.*—While on tour it was noticed that in one division there was a local practice of burying teak stumps when planting them. To test the efficacy of this practice experiments were done at four centres during the year in which four treatments were applied (A) planted on 1st April 1936 normally, (B) planted on 1st April 1936 buried, (C) planted on 1st June 1936 normally, and (D) planted on 1st June 1936 buried. In treatments (B) and (D), the stumps were made normally with 1″ of stem and 9″ of root and planted in the ground 1″ lower than they were originally in the nursery, i.e., planted with the top of the stem flush with the ground.

In the late planting (June) the treatment produced no appreciable difference in survival percentage or in mean height growth from the control. In the early planting, however, although there

was no appreciable difference in mean height growth, in survival percentage the burying produced much better results than the control in three out of the four experiments while in the fourth experiment (at Topslip) the reverse was the case. The experiments are being repeated.

Abbreviated results are as follows :—

Locality.	Survival percentage of stumps planted on.				Mean height growth of stumps planted on.			
	1st April 1936.		1st June 1936.		1st April 1936.		1st June 1936.	
	Buried.	Normal.	Buried.	Normal.	Buried.	Normal.	Buried.	Normal
Begur	99	96	93	98	32·2	24·8	11·3	12·1
Dhoni	86	33	92	94	37·5	42·3	24·2	24·1
Walayar	60	24	84	63	35·3	33·2	22·1	20·8
Topslip	26	68	94	88	23·3	25·2	14·8	14·5
Average ..	68	55	91	86	32.1	31·4	18·1	17·9

The above figures also give another example of the results of extreme early planting compared with normal monsoon planting. The ratio of the mean height growth of early planting to that of late planting is 1·76 : 1.

(For full experimental data see paragraph 298.)

99. It should be noted however that a practical difficulty arises with this method of burying stumps, after planting and before the sprouting of the stumps, an inspecting officer, to make sure that stumps have really been planted, has seriously to disturb them in order to see them. In consequence of this, last year in one regeneration area a portion was completely missed out in the original planting and it was not discovered until the replacement of casualties was done.

100. *Stump planting—Storage of stumps—Teak.*—In each of three centres, two experiments on the storage of teak stumps were done. In all these experiments teak plants were dug up in the nursery at intervals of five days, made into stumps, tied into bundles and stored in well ventilated rooms. The period of storage ranged from 0 to 35 days. In one set of experiments the stumps were dug up before the plants had sprouted in the nursery and were planted on 10th April 1936 and in the other set the plants were dug up after they had sprouted and were planted on 5th May 1936.

The stumps dug up before sprouting took place stored well for fifteen days except in one case and then very rapidly deteriorated, while those dug up after sprouting, deteriorated much less, in one case storing well for 30 days. There was practically no difference at all in the resulting height growth of all survivals of all periods of storage.

101. In 1933 which was a good year climatically stumps kept for four weeks, in 1934 (a poor year) for three weeks, while in 1935 (an abnormally poor year) they kept for two weeks and still gave reasonable survivals. This indicates that even under exceptionally adverse weather conditions they will keep long enough to be

sent from any one part of the Presidency to any other without fear of serious deterioration.

(For full experimental data see paragraph 299.)

102. *Irrigated teak plantations.*—In 1932 experiments were started in the raising of irrigated teak plantations near Mettupalayam after clear felling and burning mixed deciduous forest of poor quality. The area has an average annual rainfall of 56·2″ and most of this comes from the north-east monsoon.

Two methods of irrigation have been tried so far (*a*) by flooding (as in paddy cultivation) and (*b*) by percolation from shallow channels, one channel per two rows of teak. The indications so far are that flooding is more difficult and more expensive to do and also uses more water than percolation. There is practically no difference at all in the resulting growth of the teak between the two methods.

In the 1932 plantation in which irrigation was stopped after 2½ years, it was started again in the fourth year and three treatments applied (*a*) control, (*b*) irrigated by percolation once a week, (*c*) irrigated by percolation twice a week. During the year the average height increment per tree for the three treatments was (*a*) +3·18′, (*b*) +5·68′, (*c*) +7·12′, while the corresponding diameter increment per tree was (*a*) +0·65″, (*b*) +0·76″, (*c*) +0·79″. In one irrigation the water is allowed to flow through the area for three hours in the early morning.

103. *Swietenia macrophylla—Planting in the open.*—Experimental plot 140 Nilambur division has as its object to determine from the growth and susceptibility to borer attack the best size of transplant and best espacement for Mahogany on an area of mixed deciduous forest which had been clear felled and burned. It is a large scale experiment arranged in randomized blocks and consists of espacements of 3′ × 3′, 6′ × 6′ and 9′ × 9′ and three sizes of transplants, 6″ to 12″, 12″ to 18″ and 3′ to 4′.

At the end of the first year there was very little difference between the treatments and no borer attack had occurred. The experiment will have to be observed carefully for the next few years.

104. *Swietenia macrophylla—Planting under an artificial shade crop.*—In Experimental plot 151 Palghat division, a shade crop of *Trema orientalis* was raised in 1935 by direct sowing at an espacement of 6′ × 6′. Owing to monsoon floods and consequent wash of the seeds it developed as a broadcasted crop. In June 1936, the *Trema* was roughly 6′ high and was underplanted with three sizes of Mahogany transplants, (i) 5″ high, (ii) 15½″ high and (iii) 27″ high. Results at the end of the first year showed little difference between the treatments, the smallest size of transplant however doing slightly the best.

It has been obvious during the year that the shade was too heavy for the Mahogany, and in the coming monsoon the *Trema*

which is now 12′ to 15′ high is going to be thinned and reduced to an even 6′ × 6′ spacing.

105. As a result of the work seen in Bengal several further experiments are being initiated this year in which Mahogany will be raised simultaneously with the shade crop, and in addition the Mahogany will be split up into small blocks by other non-Meliaceous species. The object is to minimize shoot borer attack by means of the shade crop and to localize collar borer attack by this segregation of the Mahogany plots.

106. *Swietenia macrophylla—Season of infection and incidence of pests*.—A series of 21 experiments has been started during the year to endeavour to determine the seasons of infection and the incidence of the two main pests of Mahogany, the shoot borer (*Hypsipyla robusta*. Moore) and the collar borer (*Pagiophloeus longiclavis*. Mshl.) under different conditions of environment. The experiments are at six centres, two of which are in evergreen forest and the remainder in deciduous forest. The ages of plants experimented with vary from 1 to 5 years and the conditions are evergreen top canopy cover, clear felled evergreen followed by a cover crop, clear felled deciduous forest, Mahogany in the open, under an artificial shade crop of *Trema*, and natural regeneration under the shade of mother trees.

107. The experiments were started late in the year (i.e., after the main attacks of both pests which are usually shortly after the monsoon) but definite attacks have been recorded as follows :—

Shoot borer.—Dhoni (deciduous and in the open) last half of December. Nilambur (deciduous and in the open) early December and mid-January. Kannoth (deciduous and in the open) early January and late February. Chandanathode (evergreen top canopy shade) late December and mid-April. No attacks have yet been recorded in these experiments in natural regeneration under mother trees or artificial regeneration under shade in deciduous areas.

Collar borer.—The only recorded attacks with this pest have been at both evergreen centres under top canopy shade. Karianshola in late January and mid-April and Chandanathode in mid-December, mid-January and mid-March.

Four further experiments have also been started to find the extent of infection of mature Meliaceous trees in the neighbourhood of Mahogany plantations by sack banding such trees. There are no results to record yet.

108. *Artificial regeneration of Bambusa arundinacea.*—Experiments were done at Begur and Topslip in which direct sowing, planting of 1-year old transplants and planting of 1 and 2-year old rhizomes were compared. In one experiment transplanting of seedlings gave easily the best results while in the other, rhizome planting proved the superior method.

Two different methods were adopted in the rhizome planting however and further experiments have been started to test these

methods. In both cases the seedlings when a few inches high were pricked out at an espacement of 6″ × 6″ and allowed to develop rhizomes. At Topslip where rhizomes did well, before planting, the shoots were cut off to about 3″ or less and they were planted deep and if there were a bunch of shoots the small rhizomes were not separated, whereas at Begur where rhizomes did not do well, shoots were left to 6″, they were planted at a normal depth and in the case of clump of shoots the small rhizomes were cut to one piece per shoot.

Abbreviated results are as follows :—

Locality.	Treatment.	Survival per cent.	Mean height in inches.
Begur Experimental Garden, Experiment 80.	Sowing	84	21·8
	One-year transplants	95	53·0
	One-year rhizomes	39	25·2
	Two-year rhizomes	50	31·2
Topslip Experimental Garden, Experiment 138.	Sowing	12	12·9
	One-year transplants	46	14·3
	One-year rhizomes	91	18·3

109. *Artificial regeneration of Dendrocalamus strictus.*—A similar experiment was done at Begur with *Dendrocalamus strictus* and with similar results, i.e., seedlings produced the better result.

One year seedlings.		One year rhizomes.	
Survival per cent.	Mean height in inches.	Survival per cent.	Mean height in inches.
70	34·6	47	46·5

110. *Bambusa arundinacea—Transport of young rhizomes to distant places.*—During the year an experiment was done to see whether young *Bambusa* rhizomes grown from seed would stand transport to distant places and whether they would thrive in such places which have climates different from that in which they were raised. Consignments of rhizomes were sent to ten different districts. In most districts the rhizomes after planting produced green shoots but in all except two districts the resulting survivals were very few. Most districts however report very poor climatic conditions after planting. It appears therefore that these rhizomes will stand a journey without serious deterioration but need good subsequent climatic conditions for them to establish themselves.

111. *Artificial regeneration of Chloroxylon swietenia.*—The transplanting experiment reported in paragraph 82 of last year's report was observed during the year and re-measured. Casualties have been negligible but the growth is very slow. A number of plants apparently dead last year have put up new shoots from the base. The plot shows a survival percentage of 92 and a mean height growth of 11·9″ at the end of the second year.

A further experiment was done at Begur comparing large and small transplants and large and small stumps of this species. All four treatments gave almost exactly the same result at the end of the year, a survival percentage of 72 and a mean height growth of 7″.

112. *Schleichera trijuga—Comparison of sowing, transplanting and stumping.*—Experiments were done at Dhoni and Begur in this subject. Results were greatly in favour of stump planting this species but many repetitions to confirm the indications are necessary.

Abbreviated results are :—

Locality.	Sowing.		Transplanting.		Stumping.	
	Survival percentage.	Mean height.	Survival percentage.	Mean height.	Survival percentage.	Mean height.
Begur Experimental Garden, Experiment 84	40	8·5	40	5·4	90	7·2
Dhoni, Experimental Garden Experiment 119 ..	7	14·1	22	14·3	not done.	

113. *Castanospermum australe (Australian chestnut).*—A small quantity of seed was received from Australia for trial. The seed was received too late for direct sowing and in consequence it was raised in a nursery and during the monsoon it was tried by transplanting and stumping.

Stumping failed completely and transplanting resulted in about 30 to 50 per cent survivals. Judging by the ease of germination in the nursery it is a species that will do best by direct sowing. The localities of trial were Begur, Kannoth, Nilambur, Dhoni and Topslip.

114. *Araucaria cunninghamii.*—An experiment in the transplanting of this species as 1-year old transplants 8″ high in a clear felled area of mixed deciduous forest gave a survival percentage of 83 at the end of the first year.

115. *Teak coppice forest—Filling in blanks with stumps.*—Observation of Experimental plot 47, Palghat division was continued. In this experiment an attempt was made to fill in fairly small blanks in a teak coppice forest by using teak stumps at the time of felling. This was done in 1926 over 1 acre. In 1937 after 11 years (i.e., more than one-third of the rotation of 30 years) 55 per cent of the stumps were still surviving but were only approximately half the girth and half the height of the coppice poles surrounding them.

Although these stump plants have not taken their place in the crop, yet, if they survive to the end of the rotation they will coppice, and the object of their introduction will have been achieved. This however does not appear likely as they are now very heavily suppressed.

116. *Teak plantation.—Casualty replacement in the second year.*—The investigations into the fate of casualties replaced in the second year of teak plantations in localities having the West Coast type of climate were continued. The indications are that such replacements do not take their place in the crop and are therefore not financially worth while.

The following table shows the results obtained so far :—

Division.	Experiment number.	Area.	Year of casualty replacement.	Percentage of original plants replaced.	At the end of second year of plantation. Percentage replacements surviving.	Average height replacements / Average height plantation.	At end of third year of plantation. Percentage replacements surviving.	Average height replacements / Average height plantation.	At end of fourth year of plantation. Percentage replacements surviving.	Average height replacements / Average height plantation.	At end of fifth year of plantation. Percentage replacements surviving.	Average height replacements / Average height plantation.
Palghat ..	135	2	1933	13	77	1/6	62	1/2	50	1/2	43	1/2
Palghat ..	140	½	1934	33	48	1/6	26	1/2	23	1/2	..	..
Coimbatore South	61	½	1934	20	17	1/5	17	1/3	16	1/2	..	..
Palghat* ..	145 (1)	½	1935	19	85	1/5	74	1/2	..	..	..	..
Palghat† ..	145 (2)	½	1935	18	85	1/7	84	1/2	..	..	..	..
Palghat ..	149	3/5	1936	25	99	1/2	..	..	..	..	..	..

* Flat country. † Hilly country.

In no case so far investigated have the replacements ever become more than half the height of the surrounding plantation even at the end of the fifth year of the plantation and this is usually the year of first thinning. It is also seen from the table that many of the replacements die out.

These considerations of course only apply to cases where casualties are comparatively few and not to the wholesale replacement of a failed plantation.

117. *Effect of taungya (ponam) crops on the growth of teak in a plantation.*—To obtain further evidence of the retarding effect on the height growth of teak of some ponam crops Experimental plot 33, Wynaad division was started during the year. This is a repetition of Experimental plot 17, Wynaad division, the results of which have been reported in the annual report for the last two years.

It is a large scale experiment consisting of 28 randomized sub-plots; four sub-plots to each treatment. In the first year three of the treatments are controls with no taungya crop, three of the treatments are teak with a ponam crop of " ragi " (*Eleusine coracana*) and the seventh treatment is teak with a ponam crop of " dhall " (*Cajanus indicus*).

At the end of the first year results showed that the " ragi " crop had had a retarding effect on the height growth of the teak of 39 per cent while the " dhall " crop had had no effect. There was no difference between treatments in survival percentage.

This substantially confirms previous years results.

(For full experimental data see paragraph 300.)

118. *Effect of planting distance on the height growth of the teak and on weeding costs.*—Experimental plot 21 Wynaad, in which planting at 3′ × 3′ is compared with that at 6′ × 6′, was re-measured. It is now three years old. There is no appreciable

difference in survival percentage but the 6′ × 6′ teak is significantly ahead in mean height growth to the extent of 20 per cent. Weeding costs in the 6′ × 6′ area are in the proportion of 1·8 : 1 to those in the 3′ × 3′ area.

Both sets of plants are now definitely above weed growth except for occasional plants and the indication is that the extra cost of planting at 3′ × 3′ is not offset by the saving effected on weeding by the closer planting. The effect on height growth up to three years is small.

It should be noted however that the area is a poor one and growth in the first three years has been slow.

(*b*) *Evergreen Rain Forests.*

119. All the artificial regeneration experiments done in evergreen rain forests with the exception of one (Experimental plot 27 Wynaad—Raising of evergreens after clear felling and burning with and without cover crops) have been planting under shade and are therefore reported in part (ix) of this chapter "Underplanting" below. (Paragraphs 189 to 207).

(*c*) *Dry Fuel Forest.*

120. *Direct sowing in a burned over area—Best season.*—Remeasurement of experiments 13 to 18 Emmanur Experimental Garden at the end of the second rains showed that the best season for direct sowing in 1935 was August 1st, but several species showed a secondary best date in early October though these results were not as good as those from the August sowings.

(For full experimental data see paragraph 301.)

121. A repetition of the above experiment was made in 1936 with six species *Acacia auriculiformis*, *Acacia planifrons*, *Acacia sundra*, *Albizzia amara*, *Anacardium occidentale* and *Cassia siamea*. Measurements in January 1937 showed the best date of sowing to be May/June with a secondary best date for some species in early September.

(For full experimental data see paragraph 302.)

122. It is to be noted the best date of sowing in 1934 was early October and thus this best date for direct sowing varies greatly each year. It is the realization of this fact that has evolved the practise of sowing in May/June and going on re-sowing at reasonable intervals until full stocking is obtained. This method is followed by most districts doing really successful rab work (vide annual report 1935–36—paragraph 99). The importance of catching this best date for sowing is shown by the greatly increased height growth obtained in comparison with early October (north-east monsoon) sowings. The mean height of all species sown on the best date was 2·1 times as great in 1935 and 5·5 times as great in 1936 as the mean height of all species sown on October 1st in those two years.

123. *Direct sowing—Comparison of dry and watered beds.*—Experiments 19 to 24 Emmanur Experimental Garden had as their object to see whether the best date of direct sowing was different when the beds were watered. Remeasurement at the end of the second rains confirmed last year's indication that the best date of sowing is the same whether the beds are watered or not. Of course the stocking of beds is improved by watering and many inter-monsoon casualties are saved.

(For full experimental data see paragraph 303.)

124. This experiment was repeated in 1936 in experiments 90 to 95 Emmanur Experimental Garden with six species and with a similar result. The species experimented with are *Acacia auriculiformis, Acacia planifrons, Acacia sundra, Albizzia amara, Anacardium occidentale* and *Cassia siamea.*

(For full experimental data see paragraph 304.)

Direct sowing—Comparison of (A) not burning but soil working, (B) not burning and no soil working, (C) burning and soil working, (D) burning and no soil working.

(*Note.*—In the experiments described in this section the soil working is that done before sowing and is not soil working or "soil aeration" done after germination.)

125. In experiments 42 to 47 Emmanur Experimental Garden of 1935 four treatments were applied in two of which the area was burned and the ash worked into the soil before sowing and in the remaining two, no burning was done. In each of these two pairs of treatments in one the soil was worked 9″ × 9″ × 6″ at each patch before sowing and in the other only enough soil working to sow the seed was done.

Remeasurement in January 1937 showed that the percentage survivals and mean height of all six species were much better in the two treatments which were burned than in the two unburned areas, and also similarly the soil working had produced much better results than the areas not soil worked. The species concerned are *Acacia leucophloea, Acacia planifrons, Albizzia amara. Cassia siamea, Dolichandrone crispa* and *Wrightia tinctoria.*

Results averaged for all six species are :—

	Area *not* burned.		Area burned.	
	Worked pits.	No soil working.	Worked pits.	No soil working.
Percentage survivals	20	7	48	25
Mean height growth in inches	14·7	9·3	19·3	17·1

(For full experimental data see paragraph 305.)

126. The experiment was repeated in 1936 (Emmanur Experimental Garden Experiments 103 to 108) with six species. Measurements in January 1937 show that both in percentage of survivals and mean height growth the plants of all six species were much better in the burned areas than in the unburned areas.

With regard to soil working, taking all six species together the plants in the soil worked areas were 20 per cent better in survival per cent and 17 per cent better in the mean height growth than the plants in the area not soil worked before sowing.

The species used were the same as in the previous year.

Results averaged for all six species are :—

	Area not burned.		Area burned.	
	Worked pits.	No soil working.	Worked pits.	No soil working.
Percentage survivals	35	24	53	50
Mean height growth in inches ..	4·1	3·6	7·2	7·0

(For full experimental data see paragraph 306.)

Combining all the above results we have very definite indications that burning is essential and that soil working before sowing is decidedly beneficial.

127. *Comparison of sowing, entire transplanting and stump planting.*—In experiments 109 to 126 Emmanur Experimental Garden 18 species were experimented with by the above three methods of regeneration. For 13 out of the 18 species direct sowing gave easily the best results, i.e., *Acacia arabica*, *Acacia ferruginea*, *Acacia leucophloea*, *Acacia sundra*, *Albizzia amara*, *Albizzia lebbek*, *Azadirachta indica*, *Cassia fistula*, *Prosopis juliflora*, *Prosopis spicigera*, *Pterocarpus santalinus*, *Tamarindus indica* and *Wrightia tinctoria*.

The remaining five species did best by transplanting, i.e., *Dolichandrone crispa*, *Feronia elephantum*, *Hardwickia binata*, *Holoptelea integrifolia* and *Soymida febrifuga*.

It is noticeable that *Albizzia amara*, *Albizzia lebbek* and *Wrightia tinctoria* did quite well by all three methods, *Azadirachta indica* and *Pterocarpus santalinus* by transplanting, and *Dolichandrone crispa*, *Holoptelea integrifolia* and *Soymida febrifuga* by stump planting although their best results were as given above.

Considering these indications with those of the past few years we get the general conclusion that in this work direct sowing gives the best results for most species that are being commonly used in district rab work. Transplanting and stump planting are only suitable for a very few species and owing to the vagaries of the climate in these dry districts are unreliable methods.

(For full experimental data see paragraph 307.)

128. *Comparison of stump planting and transplanting.*—Experiments 26 to 31 Emmanur Experimental Garden had as their objects (*a*) to find the best season for stump planting, (*b*) to compare stump planting and transplating, (*c*) to compare transplanting at the commencement of the south-west and north-east monsoons. Six species were experimented with.

Remeasurement in January 1937 showed that results with both stump planting and transplanting are very poor compared with those of direct sowing mentioned in paragraph 127 above. In

general for all species tried stump planting gave better results than transplanting. The best date of stump planting in 1935 was October 1st for *Acacia ferruginea*, *Albizzia lebbek*, *Cassia marginata* and *Cassia siamea* and August 1st for *Chloroxylon swietenia* and *Pterocarpus santalinus*.

For *Acacia ferruginea*, *Albizzia lebbek*, and *Pterocarpus santalinus* transplanting at the beginning of the north-east monsoon was better than that at the beginning of the south-west monsoon. *Chloroxylon swietenia* did best when transplanted in the south-west monsoon and *Cassia marginata* and *Cassia siamea* gave no results with transplanting at all.

(For full experimental data see paragraph 308.)

129. The experiment was repeated in 1936 (Emmanur Experimental Garden Experiments 96 to 101) using 1-year old transplants and 1-year and 2-year old stumps. Results in January 1937 showed that October 1st was the best date for stump planting with *Acacia ferruginea*, *Acacia sundra* and *Feronia elephantum*, August 1st and October 1st were equally good for *Azadirachta indica* and *Soymida febrifuga*, and *Acacia arabica* did not stump at all.

In transplanting, the best time for all species was the north-east monsoon and results with *Azadirachta indica*, *Feronia elephantum*, and *Soymida febrifuga* were quite good.

In most cases 2-year old stumps appear to be definitely superior to 1-year old stumps.

To get the true value of these results they should be compared with the results of direct sowing given in paragraph 127 above.

(For full experimental data see paragraph 309.)

130. *Stump planting—Best date.*—In previous years (and in this year also) stump planting of 1-year old plants has met with very little success and it was thought that this was possibly due to using stumps which were not old enough. In Experiments Nos. 32 to 41 Emmanur Experimental garden 1935, 10 species were experimented with and 2-year old stumps were planted on the 1st of each month from July to November.

The best date proved to be October 1st but results were very poor indeed except for *Wrightia tinctoria* which gave 21 per cent survivals by January 1937.

This result confirms those of previous years that stump planting is not a suitable method in dry fuel forests at all events for the majority of the many species tried so far.

131. *District work—" Rab-cum-kumri ".*—In 1933 experiments were started in Madura district by the Working Plan Officer in the regeneration of coppice coupes in dry fuel forests by the method of raising " rab " lines distributed throughout an area in all of which a field crop is also cultivated.

The advantage of this method is that if successful it regenerates the complete area instead of about 3 per cent as with the ordinary " rab " practice and further it costs nothing as the villager, who

raises the field crop has to look after the forest crop as part of his obligation. Further as the work is done by the villager the forest staff only have to do a little extra work in addition to their ordinary duties and thus protection should not suffer.

This method has not been reported in this administration report before as it was considered necessary to gain considerable experience of the method before recommending it. In Madura district it is now past the experimental stage and is a success. In consequence, this short note has been written for the benefit of other districts who are or will shortly be trying the method so that they may make full use of this experience gained in the comparatively large scale work in Madura division during the last four years.

132. It should however be emphasized at the outset that the experience of district work and experimental work in the " rab " method shows that success is entirely dependent on strict attention to detail in what may be considered the finer points of the work such as (*a*) beating down the piled brushwood into a compact mass before the burn (*b*) working the ash into the soil immediately after the burn and bunding to stop wash (*c*) getting full stocking as early in the season as possible, (*d*) intensive tending by soil working and giving the plants proper growing space by thinning out where necessary, etc. These points were detailed in the Annual Report for 1935–36 paragraphs 93 to 108. *They apply equally to the rab-cum-kumri method and if the forest staff do not see that the villagers attend to these points the best results will not be obtained.*

133. The area to be ' kumried ' is handed over to the villagers as soon as possible after the completion of the coppice felling. If the whole coupe is not being kumried, the area for the work should be selected in that part of the coupe last vacated by the fuel contractor as fewer stools will have thrown out coppice shoots in that part of the area.

The villagers cut any standing growth and pile it with the slash left by the contractor in convenient heaps. As far as possible the heaps should not be piled on or near living trees or stools of valuable species. Great care should be taken to see that the slash piles coincide as far as is practicable with the future ' rab ' lines. Burning, soil preparation, working in of the ash and bunding is done just as in ' rab ' work.

134. As soon as the burn is over the lines are prepared for the forest crop and these are 4 feet wide and 22 feet apart and run right through the area along the contours as far as possible. Twenty-two feet is chosen as the distance between these rab lines as it is one-third chain and easy to work with, it allows a reasonable proportion of the area for the ' kumri ' crop and also as it is about the crown spread of a normal tree in such forests, and if the ' rab ' lines are fully stocked the whole area is fully stocked. The villager is bound by agreement to supply labour to the department for necessary works in the rab lines

135. The seeds of the tree species are sown at the same time as those of the agricultural crop in two lines 1 foot apart in the middle of the 4 feet strips. This sowing is just as for ' rab ' work. The villagers look after the tree seedlings and keep them clean weeded, and soil worked free of cost until they vacate the area. Soil working, etc., is done just as for ' rab ' works. As in general the villager grows a crop in the second year also, the regeneration area is then raised and tended for two years free of cost.

136. The object of the work is to get coppice regeneration from the stools of the good species and to supplement this with artificial regeneration by sowing. A probable objection to the method is that if the burn is widespread and all good stools killed, this object may be defeated. Enumerations in three ' kumri ' series of roughly 30 acres show that about 50 per cent of the stools of useful species are so killed by the burn and the balance 50 per cent is not harmed. *It must therefore be borne in mind that owing to this mortality of good stools the rab lines through the area must be regenerated with 100 per cent success to avoid partial devastation of the area.*

137. It has been suggested that this method is inapplicable to steep slopes but inspections of the areas already kumried in Madura district show that all but precipitous slopes are possible. Quite steep slopes have already been successfully regenerated and soil wash has not been at all severe as the ground is covered by the field crop during most of the rains and the contour beds 22 feet apart make a terracing that tends to hold up the soil.

138. The almost invariable field crop is ragi (*Eleusine coracana*) with a few rows of castor plants (*Ricinus communis*) but the latter should be confined to one row of castor mid-way between the rab lines and the plants spaced about 10′ to 20′ apart in the row. Cotton, beans and peas have also been successfully raised in these areas. Further experimental work is needed to decide which are the most suitable agricultural crops (i.e., those which are least harmful to the forest crop).

The forest crop is of course the same as in ' rab ' work and in Madura district the most successful species are *Acacia planifrons*, *Azadirachta indica*, *Albizzia lebbek*, *Albizzia amara*, *Tamarindus indica*, *Wrightia tinctoria* and *Acacia ferruginea*. *Cassia siamea* although only recently introduced is doing very well.

139. Inspections of the older kumried areas show that a climber cutting and general cleaning of the area is needed about the fourth year. This work will cost about as. 6 per acre judging from the growth seen.

An interesting point noticed about the Madura work is that they get splendid results with *Azadirachta indica*, whereas most districts have difficulty with this species. In Madura however the ' neem ' seed is collected from trees marked down as frequented

by birds that like to eat this seed and it is collected from the ground after having passed through the birds. This seed gives excellent germination results.

140. That this "rab-cum-kumri" work is past the experimental stage will be seen from the fact that in Madura in 1936, 60 acres were under current kumri and in 1937 it is expected that treble this area will be dealt with.

141. It is important to note that this work is tending to make the villager "forest conscious". Kumridars who have produced a good crop of tree growth (as well as a good agricultural crop!) are very pleased with themselves and are delighted to show inspecting officers the result of their work. This should help in establishing a sense of responsibility for forest growth among the ryots and should be encouraged as in these dry fuel areas the relations between the ryot and the forest subordinate are often somewhat strained.

142. *Plantations for manure leaves.*—Some interesting work was done during the year in Salem South and Vellore West divisions on the raising of plantations for manure leaves.

In Salem South Division in two ranges *Poinciana elata* was planted from May to September by large cuttings about 5′ to 6′ long and 3″ diameter. These cuttings were planted about 1 foot into the ground. Enumeration in March 1937 showed that 78 per cent in one range and 85 per cent in the other range had produced shoots and appeared to be established. It remains to be seen how they fare in the next few years.

In Vellore West Division an area of 5 acres of very poor and scanty growth was clear felled and burned and regenerated at 6′ × 6′ espacement by the sowing of *Cassia siamea* and *Poinciana elata* seed and the planting of *Poinciana elata* cuttings. Enumeration in March 1937 showed the following success. *Cassia siamea* sown area 75 per cent, *Poinciana elata* sown area 71 per cent, *Poinciana elata* cuttings 8 per cent. It should be noted however that the *Poinciana* cuttings used in this experiment were of small girth and only 1 foot in length.

As the method appears hopeful, experiments are being initiated this year to find the best date of planting, the best depth of planting and the best size of *Poinciana elata* cuttings to use.

143. *District rab work.*—Chittoor division reports marked success with *Bauhinia purpurea*. It has so far proved a non-browsable species and suitable for use as a 'surround' particularly as its shade appears much more to the liking of *Pterocarpus santalinus* (Red sanders) than that of *Cassia siamea*.

This division also reports success with *Pongamia glabra* and *Cleistanthus collinus* neither of which species are in general 'rab' use in most districts.

144. An interesting detail of tending of *Cassia siamea* fire protection belts is reported from Chittoor division. In the thinning of such fire belts, the plants thinned should be cut at about 3 feet above ground level. If this is done they produce strong side shoots from the cut stems and thus continue to cover the ground and make a healthy and effective belt while the selected trees are growing up.

145. Marked success has also been obtained in Chittoor division in the cutting and burning of *Strobilanthes* areas followed by rab regeneration. These areas have been found suitable for the establishment of *Pterocarpus santalinus* and other species and the *Strobilanthes* has so far not re-invaded the areas treated.

146. *Canthium didymum*.—Several experiments were done with this species in Chittoor division and all tend to show that the seed germinates well but that it is very difficult to make the seedlings survive their first hot weather. The most hopeful of a poor set of results are those in which the *Canthium didymum* was sown with *Cassia siamea* and is coming up under the shade of the latter species. A set of 10 field germination tests done with *Canthium didymum* showed an average germinative capacity of 35 per cent but a plant per cent in the following March of only 15 with the probability of many more casualties in the remainder of the hot weather.

147. *Acacia arabica* (Babul).—Central Salem Division reports excellent results in the propagation of *Acacia arabica* during the last two years in conjunction with the raising of a crop of cotton. The ' Babul ' seed is sown in furrows 6 feet apart after having been navigated through goats. The cotton is sown in between the ' Babul ' furrows.

In a similar experiment in which ' ragi ' (*Eleusine coracana*) was used as the kumri crop, a good ' ragi ' crop was obtained which however proved much too dense and exhausting for the ' Babul '.

148. *Artificial regeneration of Shorea talura*.—As the natural reproduction of this species was found almost absent in most of the *Shorea* patches in North Salem Division, experiments were started during the year to find out the best method of regenerating the species. The experiments were done in two places—Deverbetta and Javalagiri. The following methods were tried :—

(1) *Shorea talura* seeds were sown in rab patches. Rabs were done as follows :—The undergrowth of other species and dead materials in the plot were removed. The dead stuff was heaped up to a height of 2 feet well pressed in patches each 5′ × 5′. The slash was burnt, the soil dug up to a depth of 4 inches and mixed up with the ash. *Shorea* seeds were then sown.

(2) Long strips each 2 feet wide and varying in length from 20 to 150 feet were dug up to a depth of 4″ to 6″ and

sowings of *Shorea* seeds carried out throughout the dug up area in lines.

(3) Ordinary patches 1 foot in diameter were prepared and sown with *Shorea* seeds.

(4) Mother trees were selected and the ground below was dug up and the fallen seeds were pressed down. These were also supplemented by sowing seeds.

The details of sowings carried out, the percentage of germination obtained, etc., are tabulated below :—

Locality.	Nature of sowings.	Date of sowing.	Number of patches sown.	Number of seeds sown.	Number of seedlings germinated.	Percentage of germination.	Number of survivals in March 1937.
1 Deverbetta (In Thalli Reserve forest and unreserve.)	i. Sowing in rab patches.	14th May 1936.	30 rabs at 5 patches to each rab.	1,200	360	30	204
	ii. Line sowings.	Do.	17 lines ..	720	311	43	216
	iii. Sown in ordinary patches.	Do.	174 patches ..	870	415	48	278
	iv. Under mother trees.	Do.	100 seeds under 4 trees.	..	11	11	8
2. Javalagiri Reserve forest.	i. Sowings in rab patches.	20th May 1936.	50 rabs at 5 patches to each rab.	1,000	276	28	160
	ii. Line sowings.	Do.	3 lines ..	820	526	64	262
	iii. Sown in ordinary patches.	Do.	77 patches ..	375	167	45	75
	iv. Under mother trees.	Do.	6 trees ..	450	46	10	36

A certain amount of destruction of seeds by rodents was noticed and also some damage to seedlings by pig.

149. *Santalum album—stump planting—Storage of stumps.*—At Denkanikota an experiment was done to find the best method of storing sandal stumps and the period for which they can safely be kept. On 27th May 1936, 1,100 stumps were made from natural forest plants of a known age (two and a half to three years old) raised by the method described in the Annual Report for 1934–35, paragraph 115. On this date 100 stumps were planted and the remaining 1,000 divided into 2 sets of 500 each. One set was kept stored with their ends covered in clay in a tin with a tight fitting lid and the other set in a gunny bag hung up from the roof of a store shed. Every alternate day 50 stumps in each set were planted, half of each of these two sets being watered every alternate day and the remainder not watered.

It was found that the climatic conditions varied very greatly from day to day during the planting period of May 27th to June 16th, and the experiment was therefore repeated in the north-east monsoon. In this repetition 100 stumps were made every alternate day from October 2nd to October 22nd and 1,100 stumps thus prepared were all planted on the last date, the storage being done in tins and gunny as in the previous experiment.

The results of these two experiments indicate (1) that sandal stumps can be safely stored in tins for three weeks before planting and still give nearly as good results as fresh stumps, (2) that stumps stored in gunny deteriorate very rapidly (in less than a week), (3) that watering every alternate day is very beneficial.

(For full experimental data, see paragraph 310.)

150. *Transport of stumps.*—To test the possibilities of the transport of sandal stumps to different places in the south-west and north-east monsoons (16th June 1936 and 17th October 1936) consignments of stumps were sent from Denkanikota to Chittoor and Emmanur. Each consignment consisted of 400 stumps which were as follows :—(A) 1½ to 2 years old packed in tins. (B) 1½ to 2 years old packed in gunny. (C) 2½ to 3 years old packed in tins. (D) 2½ to 3 years old packed in gunny. In addition, a parallel control experiment was similarly done in Denkanikota. The results of the experiment are given in the following table :—

Date of making stumps at Denkanikota.	Age of stumps.	Denkanikota. Date of planting.	Denkanikota. Percentage of sprouting of stumps stored in Tins.	Gunny.	Chittoor. Date of planting.
(1)	(2)	(3)	(4)		(5)
1936.		1936.			1936.
16th June	1½ to 2 years	18th June	16	6	20th June
	2½ to 3 ,,	..	30	20	..
17th October	1½ to 2 ,,	19th October	28	24	19th October
	2½ to 3 ,,	..	32	28	..

Date of making stumps at Denkanikota.	Age of stumps.	Chittoor—*cont.* Percentage of sprouting of stumps stored in Tins.	Gunny.	Emmanur. Date of planting.	Emmanur. Percentage of sprouting of stumps stored in Tins.	Gunny.
		(6)		(7)	(8)	
1936.				1936.		
16th June	1½ to 2 years	13	1	18th June	6	..
	2½ to 3 ,,	24	5	..	10	..
17th October	1½ to 2 ,,	95	73	21st October	25	..
	2½ to 3 ,,	91	83	..	31	..

NOTE.—The very good results of the 19th October 1936 planting at Chittoor are due to exceptionally good weather following the planting.

The above figures give us the following indications :—

(1) Sandal stumps can be sent to comparatively distant places without serious deterioration.

(2) Packing in tight tins gives much better results than packing in gunny.

(3) Two and a half to three-year old stumps give better results than 1½ to 2-year old stumps.

(4) The north-east monsoon is a better time to send the stumps than the S.W. monsoon.

151. In addition a further parallel experiment was done at Denkanikota in which the stumps were watered on alternate days after planting.

The results of this experiment are :—

Date of making stumps.	Age of stumps.	Date of planting.	Percentage of sprouting of stumps stored in — Tins.	Gunny.
1936.		936.		
16th June ..	$1\frac{1}{2}$ to 2 years ..	18th June ..	88	58
	$2\frac{1}{2}$ to 3 years ..	.... ..	98	64
17th October ..	$1\frac{1}{8}$ to 2 years ..	19th October ..	62	32
	$2\frac{1}{2}$ to 3 years ..	.... ..	72	40

152. We have experienced great difficulty in raising sandal in the Emmanur Experimental Garden and hence this year we have compared the sandal stumps sent from Denkanikota in October with local stumps from the plains surrounding the garden and from the 3,000 feet elevation hills close by.

The results are :—

Percentage sprouting at Emmanur of

Denkanikota stumps.	Local plains stumps.	Local hill stumps.
28	25	59

We thus have an indication that for sandal work at Emmanur stumps from the local hills are likely to give us the best results of stock we have so far tried.

153. *Santalum album—inducing natural regeneration of known age.*—In North Salem Division where most of the spike disease research is going on, a large number of sandal plants of known age are needed for experimental purposes. In consequence during the last few years an interesting method of inducing natural regeneration of known age has been evolved. This was described in the Annual Report for 1934–35 paragraph 115 which is here repeated :—

> " Suitable mother trees are selected in the forest and all regeneration under them is pulled up. The ground under these mother trees is dug up to a depth of about 4 inches. After the next seed fall a mass of regeneration comes up under the tree which is removed and stump planted as and when required. . . ."

No statistics of this work had been kept and in consequence during the year an experiment was done in which accurate figures were kept. Twenty-two mother trees were selected and the aggregate area under them of 3,183 square feet was treated as described above in October 1936, the soil under each tree being raked up and the fallen seeds were pressed into the soil. In January 1937 an enumeration showed a total of 2,275 healthy seedlings under the 22 trees, i.e., 104 seedlings per tree or nearly 1 seedling per square foot treated.

154. *Influence of host plants on the seeding of Santalum album.*—Experiments in this subject were continued during the year and results confirm the conclusions already drawn—namely, that sandal plants deprived of their hosts either do not seed at all or seed only once a year and that too is only a sparse seeding. The fruits in such cases do not mature.

(*Note*—Sandal normally seeds twice a year.)

The results are tabulated :—

Plant number.	Number of seasons in which hosts were healthy.	Number of seeds produced.	Number of seasons in which hosts were sickly, dead or small.	Number of seeds produced.
3	8 seasons ..	233	5 seasons dying ..	2 seeds in one season. 1 seed in one season. Nil in others.
5	4 seasons ..	195	8 seasons dying ..	1 seed in one season and nil in other season.
120	2 seasons ..	18	Hosts small in 4 seasons. No hosts in 7 seasons.	6 seeds in two seasons and nil in others.
113	11 seasons ..	90	Sickly 2 seasons. No hosts 1 season.	4 seeds in one season, nil in others.
117	3 seasons ..	20	Sickly 4 seasons, small 6 seasons.	Nil.
116	6 seasons ..	48	Sickly 1 season, very small 3 seasons dead 3 seasons.	13 seeds. Nil. 1 seed in 1 season.
115	11 seasons ..	117	Sickly 1 season, no hosts 1 season.	13 seeds. 3 seeds.

155. *Obligatory parasitism of sandal.*—Sandal plants which had killed out their hosts in pots were kept under observation without introducing new hosts to find out how long sandal would live without hosts. The results are tabulated below :—

Plant numbers.	Date on which hosts were dead.	Date on which Sandal died.	Remarks.
1328	29th September 1936.	25th February 1937.	
1432	15th December 1935.	8th October 1936.	Found struggling on 23rd August 1936.
1279	7th January 1936.	8th January 1937.	The leaves gradually became smaller and smaller and at a certain stage, some appeared like "spike" leaves.
3105	Do.	18th January 1937.	
839	Do.	25th December 1936.	
916	15th December 1935.	18th January 1937.	
834	Do.	25th December 1936.	

The above results strongly confirm the conclusion already drawn that Sandal is an obligatory parasite.

156. *Extent of parasitism of sandal on various hosts.*—The following experiments were carried out under controlled conditions. Sandal plants in combination with various hosts raised in pots in the potculture plot at Denkanikota were carefully removed from pots without causing any injury to their rootsystems and the haustoria counted. During the examination it was found that haustorial connections were mostly on tender roots and only a very small number was found on older roots. The age of sandal plants associated was three years. The amount of parasitisation of various hosts was counted and tabulated below :—

List of species classified according to the amount of parasitisation.

Poor. (Below 25 haustoria.)	Moderate. (20 to 100 haustoria.)	Well parasitised. (Over 100 haustoria.)
Azima tetracantha.	*Ixora parviflora.*	
Fluggea leucopyrous.	*Strychnos nux vomica.*	*Pongamia glabra.*
Aloes.	*Flacourtia sepiaria.*	*Mundulea suberosa.*
Psidium guayava.	*Scutia indica.*	*Acacia farnesiana.*
Caesalpinia coriaria.	*Jatropha curcas.*	*Murraya koenigii.*
Grevillea robusta.	*Butea frondosa.*	*Acacia pennata.*

Poor. (Below 25 haustoria.)	Moderate. (20 to 100 haustoria.)	Well parasitised. (Over 100 haustoria.)
Rhus mysorensis.	*Bamboos.*	*Azadirachta indica.*
Carica papaya.	*Zizyphus jujuba.*	*Melia azadirach.*
Eugenia jambolana.	*Zizyphus oenoplia.*	*Cajanus indicus.*
Opuntia dillenii.	*Ehretia buxifolia.*	*Ocimum sanctum.*
Euphorbia spp.	*Dichrostachys cinerea.*	*Capsicum frutescens.*
Aloe barbadensis.	*Melia dubia.*	*Terminalia arjuna.*
Cudrania javanensis.	*Citrus medica.*	*Casuarina equisetifolia.*
Thevetia neriifolia.	*Schleichera trijuga.*	*Ruta graveolens.*
Webera corymbosa.	*Wrightia tinctoria.*	*Pittosporum floribundum.*
Diospyros berberis.	*Flemingia congesta.*	*Albizzia amara.*
Jatropha gossypifolia.	*Tamarindus indica.*	*Solanum seaforthianum.*
Carissa carandas.	*Breynia rhamnoides.*	*Lantana.*
Proteum caudatum.	*Vitex pubescens.*	*Toddalia aculeata.*
Sansevieria zeylanica.	*Canthium didymum.*	*Ficus spp.*
Kalanchoe floribunda.	*Euphorbia tirucalli.*	*Acacia cyanophylla.*
Plumbago zeylanica.	*Capparis sepiaria.*	*Cassia siamea.*
Cedrela toona.	*Bauhinia racemosa.*	*Acacia suma.*
Prosopis juliflora.	*Dodonea viscosa.*	*Pterocarpus marsupium.*
Gmelina arborea.	*Chloroxylon swietenia.*	*Dalbergia latifolia*
	Bassia latifolia.	*Holarrhena antidysenterica*
	Tectona grandis.	*Dalbergia sissu.*
	Stephegyne parviflora.	*Cassia laevigata.*
	Erythroxylon monogynum.	*Cordia myxa.*
	Zizyphus trinervia.	*Acacia ferruginea.*
	Argyreia cuneata.	*Pithecolobium dulce.*
	Chickrassia tabularis.	*Lycopersicum spp.*
	Adenanthera pavonina.	*Anogeissus latifolia.*
	Murraya exotica.	*Cassia fistula.*
	Semecarpus anacardium.	*Cassia montana.*
	Holoptelea integrifolia.	*Tephrosia candida.*
		Grewia orientalis.

The results indicate that there is much variation in the amount of parasitism by sandal on different species of host plants. Though a certain number of plants may exist round sandal apparently as hosts there is the possibility of their not actually serving as hosts.

157. *Soil working in the first year.*—Experiments in recent years in our good teak areas have shown that soil working by forking (the mis-called soil ' æration ') is of great expense and very doubtful utility. In the last few years in the development of "rab work" in dry fuel forests opinions have differed as to the merits of soil working in these dry areas. Last year seven experiments were started to test its efficacy and below are given the results of these early experiments which are striking.

Two sets of experiments were done. In the first set, plants were raised on a very poor soil without a burn so that they would be small and need all possible efforts to make them survive the hot weather. In the second set plants were raised on an average soil, regeneration being preceded by a burn, so that the plants would be of reasonable size at the end of the North-East monsoon.

Soil working was done once a month from early December onwards. The operation was done in lines between the plants, care being taken that the soil within 3 inches of each plant was not disturbed. The first operation was a scratching of the soil

to a depth of about 1″ to 2″ and each further soil working proceeded deeper and slightly farther away from the plant line until a depth of about 9 inches had been reached. (This is district practice in some of the districts producing the best ' rabs '.)

158. In the set of experiments where plants were initially only 2 inches high in December 1935 and it was unlikely that they would survive the hot weather, in January 1937, one year later, in the treatment where soil working was done *seven times as many plants had survived* as compared with the control. With regard to mean height growth, the soil worked plants which started 24 per cent smaller than the control, at the end of one year were 310 per cent. taller. With all species the final results were very significant.

Abbreviated results are as follows :—

Emmanur Experimental Garden Experiments, No. 3 A B & C.

Species.	Treatment.	Initial. 18th December 1935. Survival per cent.	Initial. Mean height in inches.	Final. 5th January 1937. Survival per cent.	Final. Mean height in inches.
Acacia ferruginea	Control	61	3·05	3	5·30
	Soil worked	54	3·09	29	7·30
Albizzia amàra	Control	64	2·21	8	13·50
	Soil worked	69	1·65	48	22·00
Cassia siamea	Control	29	1·62	..	..
	Soil worked	26	0·64	8	27·84
Average for all three species together.	Control	51	2·29	4	6·27
	Soil worked	50	1·79	28	25·71

159. In the second set of experiments when soil working was begun in January 1936, the plants were 9 inches high. At the final measurement in January 1937 (i.e., one year later) in survival percentage the soil worked plants were 15 per cent better than the control. In mean height growth the soil worked plants were 6 per cent poorer than the control to start with and one year later they were 49 per cent better.

Abbreviated results are given in the table below :—

Emmanur Experimental Garden Experiments Nos. 78 to 81.

Species.	Treatment.	Initial 27th January 1936. Survival per cent.	Initial Mean height in inches.	Final 12th January 1937. Survival per cent.	Final Mean height in inches.
Acacia ferruginea	Control	84	12·07	82	29·60
	Soil worked	78	12·05	75	32·50
Anacardium occidentale	Control	41	5·83	21	10·10
	Soil worked	65	6·55	56	22·40
Cassia siamea	Control	96	8·19	65	24·90
	Soil worked	96	7·96	86	40·80
Pithecolobium dulce	Control	94	11·11	42	35·50
	Soil worked	80	8·78	54	43·30
Average of all four species together.	Control	79	9·30	53	25·03
	Soil worked	80	8·84	68	**37·25**

160. In 1936 a further set of experiments were started in this subject and the conditions of these experiments were made to conform as far as possible with district rab practice. *Acacia ferruginea* and *Cassia siamea* were raised by sowing in May 1936 in two large compact blocks each 40 lines of 15 plants. In July 1936 when stocking was fairly complete soil working was started. The soil working was done in blocks of 5 lines of 15 plants each and arranged with the control in the order A B B A, etc. The treatment was applied once a month until the middle of January 1937 when a deep soil working was done and the plots left over the hot weather. Measurements in mid January 1937 at the time of this deep soil working showed little difference in survival percentage between the two treatments but in mean height growth the soil worked plants were significantly 20 per cent better than the control.

Abbreviated results are given in the following table :—

Emmanur Experimental Garden experiments Nos. 82 *and* 83.

Species.	Treatment.	Initial 11th July 1936. Survival per cent.	Initial 11th July 1936. Mean height in inches.	Interim 4th January 1937. Survival per cent.	Interim 4th January 1937. Mean height in inches.	
Acacia ferruginea ..	Control ..	73	7·19	80	22·80	With both species differences are significant.
	Soil worked ..	77	7·51	86	27·00	
Cassia siamea ..	Control ..	96	2·20	98	32·40	
	Soil worked ..	88	1·90	99	38·60	
Average of both species together.	Control ..	85	4·70	89	27·60	
	Soil worked ..	83	4·71	93	32·80	

A further measurement will be taken at the end of the hot weather, treatments will be applied before and after the next monsoon and final measurements taken in January 1938.

161. The work done so far thus shows that in dry fuel forests soil working is very beneficial if plants are small (due to late germination or poor burn) at the end of the rains and results in a very much bigger survival percentage and mean height growth than if no soil working is done. If the rab regeneration has proceeded normally the soil working produces a very much quicker early height growth. So far we have done nine small scale experiments and our first two large scale experiments are still in progress. Results although very striking must therefore be received with caution until they have had confirmation.

(vi) Afforestation.

Grassland Catchment areas.

162. *General.*—Experiments to examine the possibility of re-afforesting some of the important catchment areas of the Nilgiris were continued. The indigenous sholas of these areas are rapidly disappearing, chiefly due to fire and grazing, and in many places have completely degenerated to grass land.

These grass land areas are very poor and very exposed and regeneration is difficult as we get heavy frosts, followed by a severe drought in the hot weather.

We have two main experimental gardens at Jacko's Nulla and Brooklands and these have rather different climates. Frost is more severe at Brooklands than at Jacko as is shown by the fact that the former had twice as many nights of frost as the latter during the last year and the lowest temperature recorded at Brooklands was 18°F as against 22°F at Jacko. The day temperature is also distinctly higher at Brooklands than at Jacko, the highest temperature recorded at the former being 100°F as against 87°F at Jacko. The severity of the conditions under which we are working is shown by the fact that on one night at Jacko in January this year the temperature fell to 22°F and this was followed by a maximum day temperature of 86°F, i.e., a *range* of 64°F in a few hours, and it must be remembered that Jacko has the less extreme climate of the two experimental gardens.

As a result of the above differences, afforestation results have been much more successful at Jacko, than at Brooklands.

163. *Brooklands Experimental Garden.*—Work was started in 1934 and owing to lack of stock only direct sowing was done. Among the nurse species Broom (*Cytisus scoparius*) has done well, *Cassia tomentosa* and *Dodonea viscosa* both germinated well but have been repeatedly killed back by frost. Of the tree species tried, most have succumbed owing to the severe frost.

It must be noted however that the protection of the plot against fire and grazing and also the soil working done in experimental work has resulted in the appearance of numbers of *Acacia dealbata* root suckers the tallest of which is now 25 feet high.

In 1935 in addition to direct sowing, entire transplanting, stump planting and the planting of cuttings was tried. Among the sowings of tree species *Hakea saligna* had done well and *Acacia dealbata*, *Eugenia arnottiana* and *Callitris rhomboidea* have done fairly well. As in the previous year Broom has done best among the nurse species.

Of the transplants, *Hakea saligna*, *Callitris rhomboidea*, *Acacia melanoxylon*, *Acacia dealbata*, *Cupressus macrocarpa* and *Eugenia arnottiana* were tried but succumbed to a large extent due to frost.

Acacia melanoxylon and *Mahonia leschnaultii* have given promise of success from stump planting and *Salix babylonica* and *Salix tetrasperma* from cuttings.

Indications of these two years work were that soil working in lines or pits for planting was insufficient to remove the intense root competition of the grass and also in lines and pits frost protection is difficult. In 1936 therefore plots 20′ × 16′ were completely dug up to a depth of 9 inches and all grass roots, etc.,

removed. Frost protection was done by a pandal over each plot. Each plot was divided into six sub-plots and in these sub-plots were put those species which had given us greatest promise in previous work. Each sub-plot had a surround of nurse species. The experiment has been a success even in the difficult conditions of Brooklands. In May 1937 eight of these plots showed the following results.

Nurse species.

	PER CENT.
Broom	80
Hypericum mysorense	23
Rubus moluccanus	26

Tree species.

Hakea saligna—transplants	81
Acacia melanoxylon—stumps	78
Acacia melanoxylon—transplants	40
Cupressus macrocarpa—transplants	37
Acacia dealbata—transplants	22
Acacia dealbata—stumps	21
Eugenia arnottiana—transplants	18
Eugenia arnottiana—stumps	3

Mahonia leschenaultii stumps have not finished sprouting yet afer the frost but already show a high percentage of survivals. *Salix babylonica* and *Salix tetrasperma* cuttings planted in some of the moister portions are doing well.

164. *Jacko's Nulla Experimental Garden.*—All the experiments done in Brooklands Experimental Garden have been replicated at Jacko with similar but much better results.

In the 1936 work Broom, *Dodonea viscosa* and *Cassia tomentosa* have done well as usual but in addition *Ligustrum* has given quite good results; among tree species *Hakea saligna*, *Acacia melanoxylon* and *Acacia dealbata* have given 23, 32, and 25 per cent, respectively.

In 1936 transplants Broom, *Dodonea viscosa* and *Cassia tomentosa* have given 85 per cent, 34 per cent and 57 per cent, respectively, while among the tree species we have the following:—

	PER CENT.
Hakea saligna	59
Acacia melanoxylon—nursery transplants	80
Acacia melanoxylon—forest transplants	32
Cupressus macrocarpa—nursery transplants ...	53
Cupressus macrocarpa—forest transplants	40
Callitris rhomboidea—nursery plants	44
Eugenia arnottiana nursery plants	34

A species of *Buddleia* for use as a nurse has been found to be easily raised from cuttings and frost hardy.

In addition to the above experiments, in 1936 four plots each 22′ × 16′ were raised as in Brooklands with the species which gave most promise. These plots were frost protected by pandals and have been more successful than in Brooklands. The species and methods used are :—

Cupressus macrocarpa—transplants.

Hakea saligna—transplants.

Eugenia arnottiana—transplants and stumps.

Acacia melanoxylon—transplants and stumps.

Acacia dealbata—transplants and stumps.

Mahonia leschenaultii—stumps.

In the surrounds Broom, *Hypericum mysorense* and *Rubus moluccanus* were stump planted or transplanted.

165. *Regeneration of tree species in patches of natural Gaultheria.*—These experiments in the raising of various tree species by various methods using patches of natural *Gaultheria* as a nurse showed promise to start with but this year have failed as with severe frost the *Gaultheria* is killed right back to the ground and is thus no use as a nurse. *Hakea saligna* is the only species showing any promise now for although it is killed back like the *Gaultheria* yet it evidently gets some protection from the *Gaultheria* as it is found that it often sprouts again after the frost season.

166. *Willows—Salix species.—Salix cœrulea variety alba* (Cricket bat willow). Ten per cent of these cuttings which came from England in 1935 are still alive and have now survived two frost seasons. They have however not made much shoot during the year and it is hoped that they have been making root. Their further development is being watched with interest.

Salix babylonica and Salix tetrasperma.—The four plots planted with cuttings of these species are being maintained. They are very successful indeed and look promising. In addition these species are frost hardy.

167. *Frost protection.*—During the year experiments in different methods of frost protection were tried for all species. With the conifers three treatments were tried (*a*) control no protection, (*b*) protection of each plant by bracken or a bamboo basket, (*c*) a complete pandal in the case of close planting. The broad leaved species were protected in four ways (*a*) control no protection, (*b*) protection of each plant by bracken or a bamboo basket, (*c*) a complete pandal in the case of close planting and (*d*) by defoliation just before the start of the frost season by means of sharp scissors.

Results show that (1) Broom, the Willows and *Buddleia* are frost hardy and need no protection, (2) defoliation, is no protection against frost, (3) bamboo baskets are better than bracken for small isolated plants, (4) the best protection of all is afforded by a complete pandal about 1 foot to 1 foot 6 inches above the ground,

screened to the ground on the up hill side, (5) that this complete pandal should be kept on during the short spell of the hot weather which follows the frost season until rains are definitely established.

From these indications it appears that small closely planted plots (rather like the "propagation centres" of our sandal districts) are likely to be the best way of afforesting frost areas.

During the year also seedlings about 1 foot high of *Eucalyptus maculata*, a rather frost tender *Eucalypt*, were transplanted in a broom patch 4 feet high resulting from 1934 sowings. These seedlings have come through the severe frost season with no casualties at all in spite of no protection other than that afforded by the broom.

168. *General indications.*—The work done so far has given us the following indications :—

(1) The moister localities can be easily stocked with willow cuttings. These are frost hardy but need protection from browsing. They are also useful for basket making. Experiments are being done to find the minimum water requirements of the willows.

(2) The soil must be dug up to about 9 inches depth and all grass roots and stones removed and the larger the area dug up the better.

(3) Frost protection is most efficient by a complete pandal about 1 foot 6 inches from the ground screened on the up hill side and it is practicable up to about 15′ × 15′. This pandal should not be removed until rains have set in.

(4) Small concentrated plots are more likely to succeed than large areas of open planting owing to easier frost protection.

(5) Nurse species can be raised as follows :—

(a) Broom, *Dodonea viscosa* and *Cassia tomentosa* by sowings.

(b) *Buddleia* by cuttings.

(c) *Ligustrum*, *Rubus moluccanus*, *Rubus lasiocarpus*, *Myrsine wightiana* and *Hypericum mysorense*, are probably best raised by planting stumps got from the forest.

(6) Tree species can be raised as follows :—

(a) *Acacia dealbata*—Two-year old transplants.

(b) *Cupressus macrocarpa* and *Callitris rhomboidea* are best raised by small transplants and these transplants can come from the forest if necessary.

(c) *Acacia melanoxylon* and *Eugenia arnottiana* mossed transplants.

(d) *Mahonia leschenaultii*—stumps, and these can be from natural forest plants.

(vii) TENDING, THINNING, CLEANING, ETC.

169. *Weeding practice—teak plantations.*—In teak plantations in a West Coast type of climate the fact that weeding by forking is not superior to weeding by scraping and therefore its great extra cost is not economically justified has been conclusively proved by research results of recent years. This conclusion has been received with a great deal of scepticism and controversy particularly by those who considered the mis-called "soil æration" or weeding by forking as the saving of second rotation teak plantations. In consequence of this scepticism, last year further large scale weeding experiments were started as it was felt that further and larger scale evidence was required to endeavour to convince the last protagonists of weeding by forking.

The two large scale experiments in Nilambur and Palghat divisions, the first year's results of which were reported in last year's report paragraphs 135 to 137 were carried on through the second year of the plantations and have now been concluded. A further similar large scale experiment has reached the end of its first year in Mt. Stuart and another is being initiated at Walayar this year.

These experiments are all arranged in large randomized blocks in the form of latin squares and each covers an area of approximately 2 acres. For the reasons stated above these experiments are reported in detail.

170. In the Nilambur experiment (Experimental plot No. 134), measurements in February 1936, i.e., at the end of the first growing season after planting showed that there was no appreciable difference in percentage of survivals between the four treatments which were (A) clean scraping, (B) scraping in 4 feet strips, (C) hand pulling of weeds when possible and when not possible weed cutting (This is the control), (D) forking in 4 feet strips.

In mean height growth A, B and D, were all significantly better than the control (C). In this experiment also forking in 4 feet strips was significantly inferior to scraping in 4 feet strips.

The actual costs of weeding only were in the proportion, clean scraping : 4 feet forking : 4 feet scraping : : 3·9 : 2·5 : 1.

The cost of the control weeding is not given as a misguided attempt to do a hand pulling of weeds when a weed cutting was indicated made a comparison with the costs of the other treatments impossible.

Detailed measurements are as follows :—

Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance
A. Clean scraping	97	24·10±1·09	+ 4·50±1·36	S.
B. 4′ scraping	99	26·48±1·09	+ 6·88±1·36	S.
C. Hand pulling and weed cutting.	95	19·60±0·82	Control.	
D. 4′ forking	99	22·60±0·89	+ 3·00±1·21	S.

Comparison of (B) and (D).

Treatment.	Mean height in inches.	Difference of means.	Significance.
B. 4′ scraping	26·48±1·09	Control.	..
D. 4′ forking	22·60±0·89	— 3·88±1·41	S.

171. The above measurements take us to the end of the first growing season after planting. It has been widely believed that a weeding by forking in the middle of the first hot weather after planting was the most beneficial of all weedings and to test this belief, treatments were repeated in mid-April 1936 and measurements again taken in very early June at the commencement of the monsoon.

Detailed measurements are as follows :—

Treatment.	Survival percentage.	Mean height in feet.	Difference of means.	Significance.
A. Clean scraping	96	4·66±0·17	– 0·86±0·25	S.
B. 4′ scraping	98	5·34±0·18	Control.	..
C. H nd pulling a d weed cutting .	94	3·18±0·15	– 2·16±0·23	S.
D. 4. forking	98	5·04±0·15	– 0·30±0·23	N.S.

172. To complete the experiment treatments were repeated in mid September at the end of the monsoon and final measurements taken at the end of January 1937 at the end of the second growing season after planting. These measurements are as follows :—

Treatment.	Survival percentage.	Mean height in feet.	Difference of means.	Significance.	
A. Clean scraping	96	12·36±0·29	+ 2·26±0·42	S.	
B. 4′ scraping	95	13·21±0·27	+ 3·11±0·41	S.	NS.
C. Hand pulling and weed cutting ..	93	10·10±0·31	Control.	..	
D. 4′ forking	97	12·60±0·24	+ 2·50±0·39	S.	Control.

The actual cost of weeding only over the two years were in the proportion—

Clean scraping : 4 feet forking : 4 feet scraping : : 3 :2 :1.

As the main weeding controversy is between the relative merits of 4 feet forking and 4 feet scraping the measurements for these two treatments are repeated for clarity.

Area planted in early June 1935.

Date of measurement.	Mean height in feet. 4′ forking.	4′ scraping.	Significance.
February 1936	1·89	2·21	Difference significant.
June 1936	5·04	5·34	Difference not significant.
January 1937	12·60	13·21	Do.

The above figures show that at no time during the experiment was the extra cost of the weeding by forking economically justified.

173. In the Palghat experiment (Experimental plot 146), five treatments were used, (A) forking in 4′ strips, (B) scraping in 4′ strips, (C) clean scraping, (D) hand pulling of weeds when possible and when not possible weed cutting, (E) weed cutting control. Measurements in February 1936, i.e., at the end of the first growing season after planting showed no appreciable difference in percentage of survivals between treatments.

In mean height growth all treatments were significantly better than the control and clean scraping gave the best results of all. Forking in 4′ strips was slightly (1 per cent) but not significantly better than scraping in 4′ strips.

The actual costs of weeding only were in the proportion :—

A : B : C : D : E : : 3·9 : 2·2 : 3·6 : 2·2 : 1.

Detailed measurements are as follows :—

Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
A. 4′ forking	79	15·18±0·60	+ 4·03±0·78	S.
B. 4′ scraping	75	15·00±0·68	+ 3·85±0·84	S.
C. Clean scraping	77	17·80±0·89	+ 6·65±1·02	S.
D. Hand pulling	75	14·86±0·77	+ 3·71±0·92	S.
E. Weed cut control	85	11·15±0·50	Control.	..

Comparison of (A) and (B).

Treatment.	Mean height in inches.	Difference of means.	Significance.
A. 4′ forking	15·18±0·60	+ 0·18±0·91	N.S.
B. 4′ scraping	15·00±0·68	Control.	..

174. Treatments were repeated in mid-April 1936 and measurements taken in June 1936 to test the effect of weeding by forking in the middle of the first hot weather after planting. Detailed measurements are as follows :—

Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
A. 4′ forking	75	45·50±1·31 ..	+ 12·88±1·85 ..	S } control.
B. 4′ scraping	75	47·75±1·72 ..	+ 15·13±2·16 ..	S } N.S.
C. Clean scraping	77	50·05±1·96 ..	+ 17·43±2·36 ..	S
D. Hand pulling ..	75	41·14±1·46 ..	+ 8·52±1·96 ..	S
E. Weed cut control ..	85	32·62±1·31 ..	Control.	..

175. Treatments were again repeated in mid-September 1936 at the end of the monsoon and final measurements taken in January 1937 at the end of the second growing season after planting.

These measurements are as follows :—

Treatment.	Survival percentage.	Mean height in feet.	Difference of means.	Significance.
A. 4′ forking	70	7·03 ± 0·19	+ 2·28 ± 0·28	S } Control.
B. 4′ scraping	73	6·57 ± 0·21	+ 1·82 ± 0·28	S } N.S.
C. Clean scraping	76	6·40 ± 0·21	+ 1·65 ± 0·28	S
D. Hand pulling	73	6·88 ± 0·25	+ 2·13 ± 0·32	S
E. Weed cut control	80	4·75 ± 0·20	Control.	..

The actual costs of weeding only to the end of the experiment were in the proportion :—

A : B : C : D : E : : 3·1 : 1·8 : 2·8 : 2·6 : 1·0.

176. The following is for clearness a comparison of 4′ scraping and 4′ forking throughout the experiment.

Area planted mid-April 1935.

Date of measurement.	Mean height in inches.		Significance.
	4′ forking.	4′ scraping.	
February 1936	15·18	15·00	Not significant.
June 1936	45·50	47·75	
January 1937	84·36	78·84	

The above figures again show that at no time during the experiment was the extra cost of weeding by forking economically justified.

177. A further large scale experiment (Experimental plot 65 South Coimbatore division) similar to the Palghat experiment in all ways was started during the year. Measurements in January 1936 at the end of the first growing season after planting showed no appreciable difference in survival percentage between treatments. In mean height growth all treatments were significantly superior to the weed cut control. 4′ forking was superior to 4′ scraping to the extent of 14 per cent but this difference was not significant.

Detailed measurements are as follows:—

Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
A. 4′ forking	93	14·15 ± 0·79	+ 5·86 ± 0·89	S } N.S.
B. 4′ scraping	89	12·30 ± 0·61	+ 4·01 ± 0·73	S } Control.
C. Clean scraping	92	11·09 ± 0·57	+ 2·89 ± 0·70	S
D. Hand pulling	90	9·85 ± 0·46	+ 1·56 ± 0·62	S
E. Weed cut control	83	8·29 ± 0·41	Control.	..

The actual costs of weeding only at the end of the first year were in proportion :—

A : B : C : D : E : : 2·5 : 1·4 : 2·5 : 1·8 : 1·0.

The above figures again demonstrate that for first year weeding in a teak plantation the extra cost of weeding by forking over weeding by scraping is not justified by results.

178. The above three large scale experiments again clearly demonstrate that for three of our main teak areas the very slight increase (if any) in mean height growth obtained by forking as opposed to scraping as weeding methods in a teak plantation is in no way commensurate with the extra cost of forking. When all previous work is taken into consideration this result may be generalized for our main teak areas which have a West Coast type of climate.

We do not know whether this result applies under exceptional conditions such as swampiness, etc., and such conditions will be the object of further experiment but in general where such conditions apply, the area is not really suited to teak in the first place!

In the South Coimbatore experiment reported above, at the end of the first year the average height of the plants in all treatments is poor (11·1 inches) compared with that obtained in a more propitious year climatically. In consequence it is being continued through the second year, treatments will be repeated in mid-April and measurements taken in early July and after the monsoon, about mid-September, a final treatment applied followed by a final measurement in the following February when growth has stopped. This further treatment will give additional confirmation of the effect of a forking as compared with a scraping in the first hot weather after the formation of a plantation.

179. It should be noted that these results on weeding practice showing that the small beneficial effect of forking is not economically justified have all been obtained in clear-felled areas in mixed deciduous forest of good quality with a light friable loamy soil

and rainfall of 60 to 100 inches per annum. We do not know whether they apply to dry areas with a small rainfall and a prolonged hot weather. Experiments on soil working in dry fuel forests are in progress and preliminary results are given in paragraphs 157 to 161.

180. *Leucaena glauca as a cover crop in a teak plantation.*—In Experimental plot 25, Wynad division *Leucaena glauca* was tried as a cover crop in the first year of a teak plantation. The teak was stump planted in mid-April 1935 and the cover crop sown in June 1935. The *Leucaena glauca* needed a very great deal of attention to prevent its being smothered by weeds and even by the end of the first year when it was $4\frac{1}{2}'$ high it had still had no effect as a weed suppressor.

Measurements in January 1936 showed that the *Leucaena* teak was significantly ahead of the control teak in mean height growth to the extent of 34 per cent while there was no appreciable difference between treatments in survival percentage.

In the second year of the experiment the plot was often visited by deer and bison which several times browsed the *Leucaena* right down to the ground.

Measurements in January 1937 still showed no difference between treatments in percentage of survivals but the *Leucaena*-teak which at the end of the first year was 34 per cent ahead of the control teak was only 11 per cent better and this difference was not significant.

During the two years of this experiment the *Leucaena* has had no effect at all as a weed suppressor.

(For full experimental data see paragraph 311.)

181. *Thinning research—Teak.*—The plots at Nilambur and the Wynaad the objects of which are to determine, (*a*) the best date of first thinning, (*b*) the best intensity of thinning and (*c*) the best periodicity of thinning in teak plantations of different qualities were maintained (vide last year's report, paragraphs 143 to 146).

In the set of plots on the best date of first thinning at Panangode-Nilambur, the second group of three plots was thinned during the year according to schedule.

182. The set of plots established to test whether Dr. Craib's theory of thinning is applicable to teak plantations (vide paragraph 146 of last year's report) was observed during the year. This is Experimental plot 139, Nilambur division. In this experiment the treated plots were thinned with a 50 per cent mechanical thinning at two years old. During the year coppice shoots from the thinned stools grew up almost to the height of the the remainder of the plots and had to be recut after six months. In spite of this the treatment is beginning to have an appreciable effect in that in the treated plots the rate of height growth has slowed down a little while diameter increment has increased slightly in comparison with the control plots which are due to be first thinned at five years old.

183. *Effect of clear felling bamboo clumps—Bambusa arundinacea and Dendrocalamus strictus.*—An interesting experiment is reported from Salem Central division in the subject of bamboo working. The species experimented with were *Bambusa arundinace* and *Dendrocalamus strictus.* With each species clumps were selected, (i) with young culms and (ii) without young culms. Each of these sets were divided into two groups and in one, all culms were cut and in the other all but five or six of the youngest culms were cut.

Results up to the end of March 1937 show that :—

(*a*) All clumps of *Dendrocalamus strictus* in which five or six of the youngest culms were left uncut have grown fairly well. Every clump has produced 2 to 4 new culms and they are growing well.

(*b*) All the *Dendrocalamus strictus* clumps which were clear felled have grown very badly and only 1 clump has produced two new culms of moderate size, all the other clumps have produced a thin weedy growth like grass.

(*c*) All the clumps of *Bambusa arundinacea* in which 5 or 6 of the youngest culms were left uncut have produced 2 to 4 new culms and all are growing well.

(*d*) In the *Bambusa arundinacea* clumps which were clear felled, practically no new culms have been produced. Some of the clumps have died and the rhyzomes are decaying. Some of the clumps have put out a straggly, switchy growth like grass.

The above is confirmation that the clear felling of bamboo clumps is deleterious.

184. *Dendrocalamus strictus—Intensive tending and working.*—In Chittoor division the intensive tending and working of *Dendrocalamus strictus* has been carried on in the last four years and has proved not only interesting but very profitable in results.

The work done so far has produced the following marking rules:—

(*a*) Clumps must not be allowed to get congested.

(*b*) All misshapen or defective culms must be removed.

(*c*) No culms under one year old may be felled.

(*d*) The number of culms to be removed is—

(i) For clumps containing more than 35 culms, one culm more than the number of culms produced during the current year.

(ii) For clumps containing 25 to 35 culms, the same number of culms as have been produced during the current year.

(iii) For clumps containing less than 25 culms one culm less than the number of culms produced during the current year.

The object is gradually to bring all clumps to 25 to 35 culms each well-grown and well spaced out. It is anticipated that each such clump will yield at least eight good culms per year without any ill-effect to the clump.

185. *Santalum album—Thinning of natural regeneration.*—In an area in Chittoor division where natural regeneration of sandal has appeared to the extent of many thousand plants per acre an interesting experiment is being done on the thinning out of the sandal and the introduction of host plants.

Three treatments have been applied, (A) in which the sandal was thinned to an espacement of 15′ × 15′ and *Cassia siamea* introduced at 3′ × 3′, (B) in which no thinning was done and *Cassia siamea* introduced as in (A), (C) control.

The results so far show that the sandal has very materially improved in A and slightly improved in B.

186. *Effect of pruning young Swietenia macrophylla.*—An experiment (Experimental plot 135, Nilambur division) was started in 1935 to determine whether pruning of 8-year old Mahogany is beneficial and to see whether applying coal tar to the wounds prevents rot. During the first 18 months of this experiment 50 per cent of the untarred wounds and 32 per cent of the tarred wounds had closed completely. In both treatments the remainder of the wounds had closed to approximately one half of their original size. There is no sign of rot yet at any wound.

187. *Effect of soil working and of trenching on the growth of natural seedlings of Hopea parviflora.*—Observations were continued on the two experiments done in Coimbatore South Division, Experimental plot 47 is under full evergreen shade and in Experimental plot 46 all but the top canopy was removed. In each experiment, three treatments were applied, (A) soil working by forking 3″ deep, (B) removal of root competition by digging narrow trenches 9″ deep and 3′ apart with similar cross trenches at 4′ intervals and cutting all roots met with, and (C) no treatment at all. The treatments have been applied each year in January.

In the plot under full shade after four years there is no appreciable difference in survivals and no significant difference in mean height growth between the three treatments although the average annual increment of the mean tree during the period has been 1·36″.

In the plot under top canopy shade only although initially comparable the soil worked plot is 40 per cent and trenched plot 48 per cent ahead of the control in mean height growth both differences being significant. There is no appreciable difference in the survival percentage. In this plot the average annual increment of the mean tree has been 4·85″.

Thus the trenching is more expensive to do than soil working and no more effective.

The indications are therefore (1) that young *Hopea* regeneration needs only top canopy shade and (2) that soil working is beneficial.

(For full experimental data, see paragraph 312.)

(viii) MIXTURES.—Nil.

(ix) UNDERPLANTING.

(*a*) *Teak Plantations.*

188. *Underplanting in teak plantations.*—No new underplanting has been done but all old plots have been maintained. In the plots so far established the Burma bamboo *Cephalostachyum pergracile* is doing very well indeed and the local bamboo *Bambusa arundinacea* has been found comparatively easy to establish but takes some time to settle down. *Cedrela toona* and *Swietenia macrophylla* are easy to establish but suffer greatly from browsing and bark stripping by deer. Once they are above the reach of browsers they grow well under teak.

Hopea parviflora introduced on a lateritic slope in 1924 under a teak plantation of 1888 which failed and had been replaced by natural *Xylia xylocarpa* is a very successful crop so far.

During the year most of the teak plantations under which these underplanting experiments have been done were due for thinning. Although the thinning was fairly carefully done it was noticeable that in the felling and dragging a fair amount of damage was inevitable. In consequence of this damage (and also of damage to small plants by browsing) 2 of the 11 plots under consideration showed a negative height increment and one plot showed no increment at all.

The following table shows the progress made by the plots during the year :—

Division.	Experimental plot number.	Species.	Date of under-planting.	Mean height growth in January 1937. FEET.	Increment during the year. FEET.
Nilambur	98	*Swietenia macrophylla.*	1930	5·6	+0·5
	102	Do.	1930	2·3	+0·3
	99	*Cedrela toona* ..	1930	5·6	—0·5
	103	Do. ..	1930	5·6	+0·0
	101	*Bambusa arundinacea.*	1930	8·5	—2·9
	100	*Cephalostachyum pergracile.*	1930	28·7	+5·6
	104	Do.	1930	27·8	+5·3
	105	Do.	1931	29·8	+6·6
	106	Do.	1931	27·1	+5·7
Wynaad	8	Do.	1932	4·4	+2·0
Nilambur	138	*Hopea parviflora* ..	1929	6·1	+1·7

(*b*) *Evergreen Rain Forests.*

189. *Underplanting under shade.*—Palghat division Experimental plots 147 and 148 were remeasured. These plots have for their object the observation of the development from the sapling to the pole stage of *Mesua ferrea* and *Calophyllum elatum* crops which were raised by transplanting under evergreen forest shade in 1924.

These plots are thus now 13 years old and measure in mean height, *Mesua* 59·5″ and *Calophyllum* 58·2″ showing a height increment during the year of 3·0″ and 8·0″, respectively.

190. *Fate of gaps regenerated in evergreen forest.*—Experimental plot 36, South Coimbatore division, which was reported in some detail in last year's annual report, paragraph 154, was remeasured. In this experiment, five gaps in evergreen forest in Karian Shola were regenerated in 1930 and 1931 with *Artocarpus hirsuta, Bischofia javanica, Hardwickia pinnata, Pericopsis mooniana, Palaquium ellipticum, Gluta travancorica, Vateria indica, Acrocarpus fraxinifolius, Swietenia macrophylla* and *Araucaria cunninghamii.*

Measurements in January 1937 showed that only *Araucaria cunninghamii* and *Hardwickia pinnata* are doing any good. These species now have an average height of 57·0″ and 12·8″, respectively showing an average height increment during the last year of 9·2″ and 2·6″, respectively.

191. *Regeneration of evergreens after clear felling.*—A considerable amount of information has been gathered from experiments on regenerating evergreens under various degrees of shade. To complete the series of conditions Experimental plot 27, Wynad division was started in 1935 and has the following treatments for the regeneration of evergreens :—

(A) Clear felling and burning—no cover crop.

(B) Clear felling and burning with cover crop.

(C) Clear felling—no burning—no cover crop.

(D) Clear felling—no burning—with cover crop.

(E) Felling all but the undergrowth—no burning.

As reported last year, in 1935 treatments (A) and (C) were started and cover crops of *Tephrosia candida* were grown so that the remaining treatments could be started in 1936. To ensure comparability however this year treatments A and C were repeated and B, D and E started.

Measurements at the end of January 1937 show very fair results with most species and in all treatments but it must be remembered that at the time of measurement the full effect of the hot weather had not been felt. The species experimented with and the results so far can be seen from the following table :—

		C		A		D		B		E	
		No burn, no cover crop.		Burn, no cover crop.		No burn, cover crop.		Burn, cover crop.		Natural undergrowth.	
Species.	Stock used.	Survival per cent.	Mean height.	Survival per cent.	Mean height.	Survival per cent.	Mean height.	Survival per cent.	Mean height.	Survival per cent.	Mean height.
1. *Artocarpus hirsuta* ..	Stumps 0·3″/0·4″.	69	2·53″	63	2·44″	58	2·66″	51	2·35″	66	1·81″
2. *Swietenia macrophylla* ..	Transplants 22″ ..	88	16·26″	83	17·80″	90	16·49″	94	15·93″	92	17·04″
3. *Hopea parviflora* ..	Sowing	99	2·26″	82	2·03″	90	2·50″	81	2·07″	46	2·48″
4. *Hopea parviflora* ..	Transplants 22″ ..	94	16·93″	97	18·50″	97	26·60″	94	27·40″	96	26·60″
5. *Cedrela toona*	Cuttings 18″ ..	38	14·44″	42	13·20″	41	15·03″	29	13·10″	32	18·02″
6. *Cedrela toona*	Stumps 0·2″/0·3″.	65	3·65″	61	3·20″	76	3·54″	69	3·60″	87	7·65″
7. *Chickrassia tabularis* ..	Stumps	49	16·43″	43	16·22″	48	5·08″	78	5·30″	81	6·92″
8. *Dipterocarpus indicus* ..	Transplants 33½″.	75	17·24″	68	16·96″	39	15·40″	61	16·50″	41	11·95″
9. *Dysoxylum malabaricum*.	Transplants 13″ ..	65	7·52″	68	7·87″	63	9·17″	56	9·40″	62	9·69″
10. *Mesua ferrea*	Transplants 14″ ..	91	11·08″	89	10·18″	60	8·72″	77	9·39″	80	9·81″
Average of all species together ..		73	10·83″	70	10·84″	66	10·52″	69	10·50″	68	11·20″

It is to be noted from the above figures that the burn has had no effect at all either beneficial or deleterious. This confirms the results of experiments done in this subject during the last few years.

192. *Hopea parviflora.*—An experiment with this species has been started in North Mangalore division in which sowing under semi evergreen full canopy is compared with that in an area which had been previously clear felled and in which only the undergrowth was left.

Preliminary results after one year show that under the undergrowth the stocking, growth and general appearance of the plants is much better than that under full cover. It remains to be seen how the experiment progresses.

193. *General.*—The general difficulties experienced in regenerating evergreens under evergreen shade have been found to be (1) generally poor initial stocking, (2) slow initial growth and (3) browsing. In studying the following results it must be remembered that Experimental gardens are fenced and browsing is not allowed to occur.

The general results obtained are :—

(1) We definitely can make a success of raising artificially about half a dozen of our valuable evergreens.

(2) The best shade conditions so far indicated are those of top canopy only.

(3) The best method of regeneration is transplanting for most species. For the most tender species transplanting in baskets shows promise.

(4) Sowing generally gives poorer results than transplanting.

(5) Stumping is not a suitable method to use except in the case of *Artocarpus hirsuta*, *Cedrela toona*, and *Chickrassia tabularis*.

(6) Weeding is worth while as it gives a small gain in initial height growth and survival percentage.

(7) Pitting before planting is also worth while as although the beneficial effect is very small in the first year it becomes more prominent in the second year as the roots and their needs both get bigger.

(8) Burning before regeneration is not necessary. It not only produces no beneficial effect but it is found often to kill trees that have been left in the top canopy to give shade.

It should be noted that the two evergreen research centres, Chandanathode (in the Wynaad) and Karian shola (in the Anamalais) have rather different climates. Chandanathode has an annual rainfall of 153″ and most of this comes from the south-west monsoon while Karian shola gets 62″ each year and this is fairly evenly distributed between the two monsoons (vide paragraph 274 for rainfall statement).

194. *Best light and shade conditions for artificial regeneration.*—Experiments during the past few years have covered all shade conditions for regenerating evergreens from full evergreen shade to full light but these experiments have been done in different places and in different years. To correlate the indications obtained, Experiment 65, Chandanathode Experimental Garden was started in 1934 in which it was attempted to experiment under all shade conditions in the same experiment and in the same year. Five species were introduced by transplanting nursery seedlings in randomized lines and four shade conditions used for each species as follows :—

I. Top canopy only left.

II. Top canopy and high middle storey left.

III. All but undergrowth and low middle storey left.

IV. Complete evergreen shade.

During the experiment however some of the trees left in the top canopy in shade condition I died and this has affected I and II rendering them as I slightly less than top canopy only (about 75 per cent) II slightly more than top canopy only.

195. The following list shows the shade preferences indicated by the end of the third year :—

Dipterocarpus indicus I (less than top canopy).

Swietenia macrophylla I and II (top canopy only).

Cedrela toona
Hopea parviflora. } II (slightly more than top canopy).

Gulta travancorica III (slightly less than full evergreen shade).

The way in which the different species are progressing can be seen from the following table of height increment during the year read in conjunction with the table of survival percentage given in paragraph 313 of the experimental data.

Species.	Shade conditions. I Less than top canopy. inches.	II inches.	III inches.	IV Full evergreen shade. inches.
Swietenia macrophylla	9·50	8·10	4·08	5·60
Hopea parviflora	10·94	12·18	8·50	7·00
Gluta travancorica	15·44	17·75	8·92	4·42
Cedrela toona	19·30	22·60	16·80	8·40
Dipterocarpus indicus	12·50	10·27	6·47	2·50

(For full experimental data see paragraph 313.)

196. The experiment was repeated in 1936 using three shade conditions, I clear-felling, II top canopy and III full evergreen shade. The following table shows the establishment in January 1937 but it must be remembered that at this time the hot weather had not had its full effect.

Species.	Stock used.	Clear felling. Survival percentage.	Clear felling. Mean height. inches.	Top canopy only. Survival percentage.	Top canopy only. Mean height. inches.	Full evergreen shade. Survival percentage.	Full evergreen shade. Mean height. inchse.
1 *Artocarpus hirsuta*.	Stumps 0·3″/0·4″.	87	3·34	55	2·46	45	2·23
2 *Hopea parviflora*.	Transplant 15″.	88	20·20	95	19·50	53	21·20
3 *Hopea parviflora*.	Sowings ..	90	2·94	95	2·35	22	2·08
4 *Swietenia macrophylla*.	Transplants 21″.	82	25·80	23	23·70	..	..
5 *Cedrela toona*.	Stumps 0·3″/0·4″.	52	16·15	28	11·20	20	8·92
6 *Cedrela toona*.	Cuttings 18″.	88	22·50	72	17·58	27	17·90
7 *Dysoxylum malabaricum*.	Transplants 15″.	22	16·28	5	17·32	3	13·00
8 *Dysoxylum malabaricum*.	Sowing ..	38	5·54	20	5·25	2	6·00
9 *Dipterocarpus indicus*.	Transplants 30″.	35	31·90	30	29·60	20	32·42
10 *Mesua ferrea*.	Transplants 9″.	60	11·93	37	15·70	23	15·40

197. *Effect of burning in evergreen forest before artificial regeneration of evergreen species under top canopy shade.*—Three experiments (Chandanathode No. 101 and Karian shola Nos. 62 and 64) were done under top canopy shade in which areas were burned in randomized strips and then artificially regenerated with evergreen species. Nine species were experimented with, *Artocarpus hirsuta*, *Cedrela toona*, *Dipterocarpus indicus*, *Dysoxylum malabaricum*, *Hopea parviflora*, *Mesua ferrea*, *Swietenia macrophylla*, *Gluta travancorica* and *Calophyllum elatum*, and they were introduced by sowing, transplanting, stump planting and by cuttings as far as stock was available.

The work done thus covers 18 sub-experiments and 4,080 plants. In general there was no appreciable difference in survival percentage or in mean height growth between the burned and unburned treatments for any species and any method of introduction. The averaged results of these 18 sub-experiments are—

Area burned. Percentage survivals.	Area burned. Mean height in inches.	Area not burned. Percentage survivals.	Area not burned. Mean height in inches.
57	12·84	54	12·42

It is thus seen that over this large number of plants, various species, and methods of introduction, the burn has had the effect of producing an increased survival percentage and mean height growth of 3 per cent each.

198. The above results confirm those of previous years that burning before artificial regeneration under evergreen cover is neither beneficial nor harmful and is therefore not economically justified. There is also a serious drawback to burning under evergreen cover. Experiments have shown that the best shade conditions required for regenerating most of the species tried so far is top canopy only. Many of the top canopy trees in our evergreens are very susceptible to fire and three times in the last three years we have had to abandon areas after the burn as the fire had killed some 40 per cent of the trees intended to be left as the top canopy shade.

No further experiments in this subject will be done as it is considered that sufficient evidence has been obtained.

(For full experimental data see paragraph 314.)

199. *Direct sowing—Best date*—(Under top canopy only)—Experiments were done at each of two centres. In Chandanathode Experimental garden experiments 91, 92 and 93, *Acrocarpus fraxinifolius*, *Cedrela toona* and *Swietenia macrophylla* were experimented with. The Mahogany sowing practically failed completely, *Cedrela* showed early August and *Acrocarpus* early June and early August as the best dates for sowing. In Karian shola Experimental garden experiments 52, 53 and 54, *Acrocarpus fraxinifolius*, *Palaquium ellipticum* and *Swietenia macrophylla* all showed mid June to mid July as the best time for sowing.

It is to be noted however that in 1936 the south-west monsoon was early and these best dates of sowing are correspondingly early compared with results in normal years.

200. It is of particular interest that in a similar experiment (Karian Shola Experimental Garden Experiment No. 50) done in 1935 with *Calophyllum elatum* and which was reported last year as a total failure, the seed germinated in October/November 1936 profusely and showed early August as the best date of sowing. The average survival percentage of this experiment in January 1937 was 64. This also occurred to a similar extent in experiment 44 of 1935 at the same centre.

(For full experimental data see paragraph 315.)

201. *Entire transplanting—Best date* (under top canopy only).—Eight experiments with five species were done with the object of finding out the best date for entire transplanting under top canopy only. Transplanting was done once a fortnight from the middle of June until the middle of September.

Results indicate the best time for transplanting as—

Chandanathode	*Swietenia macrophylla* ..	Mid June and August to September.
Do.	*Cedrela toona*	Mid June and late July to August.
Do.	*Hopea parviflora* ..	Mid June to mid September.
Do.	*Artocarpus hirsuta* ..	Mid June.
Do.	*Calophyllum elatum* ..	Mid June and mid August.
Karian shola	*Artocarpus hirsuta* ..	Mid September.
Do.	*Swietenia macrophylla* ..	Mid June and late July to August.
Do.	*Calophyllum elatum* ..	Mid July (but survivals very few).

It is thus seen that (in confirmation of previous year's results) the heavy rain of the south-west monsoon is a bad time for transplanting. This period is usually in July. In years of an early monsoon transplanting can be done just before this period but in general the best time for transplanting in evergreen forest under top canopy conditions is just after the period of very heavy rain of

the south-west monsoon and this is usually August and early September. Chandanathode experimental garden experiments 94 to 98.

Karian shola experimental garden experiments 56 to 58.

(For full experimental data see paragraph 316.)

202. *Stump planting—Best date* (top canopy only).—Four experiments were done at Chandanathode to find the best date for stump planting of *Cedrela toona* and *Artocarpus hirsuta*. These experiments all indicated that the monsoon period before the really heavy rains of the south-west monsoon is most suitable. This period was mid-May to mid-July. Chandanathode experimental garden experiments 99, 100, 103-A and 104-A.

(For full experimental data see paragraph 317.)

203. *Comparison of sowing, transplanting small, medium and large transplants and stumping with small and large stumps* (under top canopy cover).—Twenty-two experiments were done with nine species to compare these various methods of raising evergreens under evergreen top canopy cover. With all species except two, transplanting was found to be the most successful method and with these exceptions (*Artocarpus hirsuta* and *Acrocarpus fraxinifolius*) stump planting generally gives the best results.

With regard to the size of transplants to be used the following tentative conclusions are drawn as to the approximate size of transplant likely to do best when percentage of survivals and increase, decrease or maintenance of initial difference in mean height growth of the various sizes of transplants are taken into consideration.

Araucaria cunninghamii—4″.
Artocarpus hirsuta—10″.
Acrocarpus fraxinifolius—14″.
Calophyllum elatum—8″.
Cedrela toona—12″.
Dysoxylum malabaricum—12″.
Gluta travancorica (does well if basketed)—14″.
Hopea parviflora—9″.
Mesua ferrea—9″.
Swietenia macrophylla—12″.

(in all cases the larger sizes grew much slower than the smaller ones and suffered many more casualties).

Previous years' results are included and the figures given are the approximate middle of a small range of size found to be suitable to the species.

(For full experimental data see paragraph 318.)

204. *Transplanting* (under top canopy cover)—*Comparison of natural forest seedlings and nursery transplants.*—Observation was continued of two experiments at Chandanathode and Karian Shola started in 1935 with *Palaquium elipticum* and *Hopea parviflora.*

These experiments combined with previous years results indicate that generally natural forest plants do better in the first year than nursery transplants but in later years suffer heavier casualties and their growth becomes slower. There thus appears to be no advantage in using natural forest plants.

(For full experimental data see paragraph 319.)

205. *Comparison of entire transplanting with naked transplants and basketed plants* (under top canopy only).—In Karian Shola experimental garden experiment 33 started in 1934, naked root transplants and basketed transplants of *Dipterocarpus indicus* of the same age were compared. At the end of three years the basketed plants show a very much higher percentage of survivals. In mean height growth the two treatments are progressing in much the same way. The experiment was repeated in 1936 with two other species *Gluta travancorica* and *Vateria indica*. In both these experiments the basketed plants are doing very much better than the naked root transplants of all sizes, particularly in survival percentage.

Thus basketing has proved the more efficient method of regeneration. This method although of course more expensive is likely to be very beneficial in the cases of important evergreen species with which difficulty is experienced in getting good initial stocking.

(For full experimental data see paragraph 320.)

206. *Propagation by cuttings—Cedrela toona* (under top canopy only).—While making stumps of *Cedrela toona* it was noticed that the top ends of the plants which had been cut off and thrown down on the ground quickly rooted themselves.

Experiment 79 Chandanathode was therefore done in 1935 to see whether this species could be successfully propagated by cuttings. In making stumps, the top end of about 1′ in length which was cut off was divided into two and the two parts planted. There were four treatments :—

(A) 6″ shoot cuttings planted vertically.

(B) 6″ shoot cuttings planted slanting.

(C) 6″ top ends planted vertically.

(D) 6″ top ends planted slanting.

The method was found very successful as shown below, the shoot cuttings planted vertically doing the best.

Treatment.		Survival percentage.	Mean height in inches.	
A 6″ Cuttings vertical	..	76	18·13	
B 6″ ,, slanting	..	60	11·92	Measurement in January 1937.
C 6″ Top ends vertical	..	84	15·60	
D 6″ ,, slanting	..	64	13·90	

This comparatively high percentage of survivals from material which is normally wasted is a valuable asset.

207. Two further experiments in this subject were done in 1936. In these experiments (Chandanathode experimental garden, experiments 103-B and 104-B) cuttings of *Cedrela toona* and *Artocarpus hirsuta* were made from one year old nursery plants and from branches of natural forest trees and planted fortnightly from May 1st to October 1st.

The *Artocarpus hirsuta* cuttings from nursery plants failed completely and those from natural forest tree branches showed only a small measure of success. The *Cedrela toona* cuttings from nursery plants in general showed a high percentage of success (better than the parallel stump planting experiment) and the best date for planting was September 1st. Cuttings made from the branches of natural forest *Cedrela* trees showed only a very small survival percentage.

(For full experimental data see paragraph 321.)

(x) Silvicultural Systems.—Nil.

(xi) Miscellaneous.

(a) Sandal Spike Disease Research.

208. *Introduction.*—The investigation was continued during the year by the Research Ranger, Denkanikota, under the directions of the District Forest Officer, North Salem, in consultation with the Conservators of Forests, Working Plans and Salem Circles, with the technical advice and general supervision of the Provincial Silviculturist.

The entomological experiments done up to September 1936 were inspected by the Imperial Entomologist (Dr. C. F. C. Beeson, D.SC., I.F.S., F.E.S.), Dehra Dun, and he kindly summarized the results obtained so far, a copy of which will be found in paragraph 246 below.

The future entomological work to be done was also outlined for us by him.

I. Nature and spread of spike disease.

209. During the year there were six new outbreaks within the district (North Salem), two in Manchi unreserve, one in Noganur, Reserved Forest, one in Denkanikota Reserved Forest, one in Government poramboke lands of Rangasandiram village and one in the patta lands of Gandaganahalli village. Of these, three localities were from $1\frac{1}{2}$ to 2 miles from previously spiked areas and three were within a mile. Careful examination of the areas supported all the factors associated with new infections recorded previously, namely :—

(*a*) The proximity to cultivated lands in which both field-crops and other indigenous herbs suffered from virus diseases of other types. Leaf mosaic on shrubs and herbs such as *Ageratum conyzoides*, *Leucas martinicensis*, *Malvastrum coromandalianum*, etc., was common. Spike like

clusters were found on *Zizyphus oenoplia*, *Scutia indica*, etc. Among cultivated plants, *Dolichos beflorus* suffered from acute leaf mosaic, *Nicotiana tabacum* from leaf mosaic, leaf crinkle and leaf curl and *Pencillaria spicata* with phyllody. These associations support the idea that far distant attacks may be through field crops. An experiment devised to prove this has not met with success during the year, as the plants failed to grow inside the cages.

(*b*) The presence of hosts which predispose sandal to spike, predominance of Leguminous hosts such as *Pongamia glabra*, *Acacias* and *Albizzias* and the pest of *Lantana* have been found common in all areas.

(*c*) *Proximity to paths.*—It is not yet known how this facilitates the transport of infection but it is an observed fact and its importance may be found in later stages of the investigation.

(*d*) Interference with hosts either by heavy loppings or by uprootal or by death of hosts due to some outside cause has also been found to be a common factor.

210. Spike control operations were instituted in all these areas and the results are dealt with individually under the heading "control of spike disease." Detailed instructions regarding control operations have been printed and supplied to all officers in Chief Conservator's Proceedings Press No. 260, dated 27th June 1936. The reward system has stimulated the subordinates to some extent to detect early infection and a sum of Rs. 40 has been distributed to subordinates in North-Salem division.

One more outbreak of a fairly large area was noticed in Dharmapuri Range in December 1936. Spike infection probably took place about two years previously and even though it is not possible to fix the exact spot of original infection now, yet the area in general bears out all the above observed facts. No control operations were instituted here as the area was too large to be dealt with early.

New outbreaks also occurred in other districts but as sufficient time has not yet elapsed no purpose would be served by enumerating them in this report.

II. Transmission of the disease.

211. (i) *Cloth cages.*—In the 6-acre plot at Javalagiri 42 plants which continued healthy inside cloth cages from April 1932 to April 1935 were opened out of the cages in May 1935 to see if they had resisted spike by virtue of their autogenic resistance and not by physical obstruction due to the cloth. On 18th March 1937, after a period of 22 months from the time of removing the cages, three plants showed the disease thus strongly indicating that these plants while caged had remained free from 'spike' due to the effective screening off of the vectors by the cloth cages.

212. (ii) *Experiment to determine the size of the vector.*—The cloth cage experiments indicated that agencies smaller than the size of the cloth meshes such as very small insects, wind borne fungus spores or bacteria, etc., are not the probable vectors.

The next stage was to determine approximately the size of the vector and with this object different mesh wire cages were designed, and natural sandal plants previously tested for their healthiness by pruning, were enclosed in them in Noganur Reserved Forest. The fungus spores or bacteria, etc., are not the probable vectors.

Serial number.	Size of cages.	Number of plants caged.	Date of caging.	Number of plants spiked.	Date of spike manifestation of caged plants.
1	20 meshes to an inch.	10	9 in March 1933 and 1 in December 1933.	Nil.	..
2	10 meshes to an inch.	10	2 in March 1933, 7 in December 1933 and 1 in September 1935.	Nil.	..
3	4 meshes to an inch.	15	3 in March 1933, 6 in September 1935 and 6 in September 1936.	Nil.	..
4	2 meshes to an inch..	10	6 in September 1934 and 4 in November 1934.	2	1 on 18th July 1936 and 1 on 18th March 1937.
5	1 mesh to an inch ..	10	10 in September 1934.	3	1 in October 1935, 1 in November 1936 and 1 in December 1936.

(The case which occurred in November 1936 was 34 days after the removal of the cage but as the minimum period of incubation is 55 days it can safely be assumed that infection took place while the plant was still caged.)

6	Not caged. (Controls).	800	March 1933..	.. 281	..

It is seen from the statement that though the cages of 1 and 2 meshes to-an-inch were started only in 1934, in a period of 28 months from November 1934 to March 1937, 30 per cent in one inch and 20 per cent in half inch meshes are spiked compared with 35 per cent among the uncaged controls.

In the cages of 10 and 20 meshes to an inch started in 1933, small types of insects such as Coccids, Ants, Chalcids, Caterpillars and Bagworms entered in plenty but in spite of this no " spike " infection took place.

The indications of this set of experiments are:—

(*a*) The insects of the types found inside 20 mesh to an inch cage are not likely to be the vectors and therefore Dr. Beeson considered that the maintenance of these cages was no longer necessary (vide Dr. Beeson's deductions in paragraph 246).

(*b*) Spike having occurred under these conditions strongly indicates that the culprit vector is probably between 1/10″ and ½″ in size.

Under Dr. Beeson's advice the cages of ½″ and 1″ mesh have been given up and the numbers of cages of mesh smaller than ½″ have been increased.

213. (iii) *Platform experiments.*—These were continued during the year with the object of finding out the minimum period and the season of infection. Twenty-eight plants were exposed both on

platforms and on the ground for periods of one month more or less coinciding with the first and last days of the months from April 1936 to September 1936.

These experiments were instituted in 1931 but with longer periods of exposure, and during these five years none of the plants kept on the ground were infected. Dr. Beeson considered this result as conclusive and suggested that further placing of plants on the ground below the platforms was unnecessary. Since October 1936, exposure of plants on platforms alone has been continued. The number of plants that got spiked after narrowing the period of exposure to a month is 5 out of 42, i.e., 12 per cent (3/28 exposed in August and 2/14 exposed in October).

These results however cannot be taken as conclusive till more evidence is obtained as previous exposures have indicated March to May as another important season of infection.

A duplicate set of these platform experiments has been carried on in Javalagiri bungalow area since May 1935 but no spike incidence has been obtained on these plants so far. The reason probably is the availability of more attractive ground plants in the experimental areas as compared with those on platforms. This fact however needs further experimental evidence.

214. (iv) *Mass infection cages at Javalagiri and Denkanikota.*—These were continued on the same lines as in 1935–36 by introducing a number of healthy and spiked sandal plants and releasing the available types of night fauna, a list of which is appended—(vide experimental data paragraph 322).

In September 1936, Dr. Beeson inspected these cages and considered that they were no longer necessary, as no additional information beyond what we already had would be obtained by further mass transmission.

The Javalagiri cage was stopped in December 1936 and all healthy plants that were inside were removed to Denkanikota experimental garden and defoliated to bring out masked infection, if any. Most of these plants have turned out to be healthy but in the case of a few, the vegetative activity is not yet complete enough to say definitely whether they are infected or not.

The cage at Denkanikota was continued till the end of the year as the percentage of infection obtained previously was only $2\frac{1}{2}$ as compared with 46 per cent in the Javalagari cage. So far, no further manifestation has taken place.

215. (v) *Compartment cages.*—As detailed in the report for 1935–36, all insect fauna caught at night were grouped into natural orders and introduced as detailed in the table below into five rooms confining either individual families or combinations of families to each room in whcih both spiked and healthy plants had been put together.

This experiment was carried out at Javalagiri with a duplicate set of four rooms at Denkanikota.

Similarly, insects caught in the day time were also dealt with to exclude more vectors, if any, among the day collection. The details are tabulated :—

Locality.	Nature of fauna released.	Date of start.	Room number.	Family of insects released.	Number of insects released in each room.
Javalagiri ..	Night collections.	3rd February 1935.	1	*Jassids* ..	5,687
		Do.	2	*Pentatomids* ..	7,897
		Do.	3	*Fulgorids and Corieds.*	5,689
		Do.	4	*Locustids* ..	4,718
		Do.	5	All other insects.	9,835
Do. ..	Day collections..	3rd November 1935.	1	All insects not caught at night.	451
		Do.	2	All insects above 265 types caught at night.	427
		Do.	3	All beetles ..	1,647
		16th September 1935.	4	*Locustids* ..	3,816
		26th October 1935.	5	All other insects collected during day time.	22,935
Denkanikota ..	Day and Night collections.	27th January 1936.	1	*Jassids* ..	2,271
			2	*Pentatomids* ..	1,764
			3	*Fulgorids* ..	768
			4	All other insects.	2,663

No transmission has taken place yet in any of the compartments. Though a negative result has been obtained, yet a valuable deduction has been drawn by the Imperial Entomologist that the vector is either an uncommon species or an uncommon strain of a common species. He is also of opinion that group or family cages are of little value as the range of insects used in the mass infection cage cannot be covered in practice throughout the year as their relative incidences vary very greatly in different months.

216. (vi) *Group cages in Kenilworth Castle area.*—The Kenilworth Castle area is a small isolated block of about 45 acres in which sandal occurs densely in about 10 acres in moats, and scattered in the other portions. Being an isolated area, it was taken up in 1931 for artificial infection experiments to study the resistance offered by a given environment to artificial grafts, and also to see if the resistance offered to spike infection was proportional to girth classes. Artificial infections were given to over 200 trees and all those that got the disease were removed. When there was no further manifestation of spike, the infected trees were all defoliated to test for masked infection. Those that showed " spike " were removed and the area was abandoned early in 1934. Till then even though some of the disease masking and diseased trees remained in the area for varying periods there was no natural infection either because the vector was absent from the area or because the vectors being few due to reasons given by the Imperial Entomologist in item 6 of his deductions had no access to such infected trees.

On 31st October 1935, however, five cases of natural infection occurred and these were removed immediately. The next case of natural infection was noticed on 17th June 1936 and since then 12

trees have been naturally infected by March 1937 indicating the existence of vectors in the area. These 12 trees are distributed over the whole area. The area being compact, it is easy to collect insects throughout the area every day and therefore the chances of getting at the culprits are greater than usual.

The Imperial Entomologist was consulted about this experiment. He was in favour of the same but suggested collection of insects by an improved technique to avoid handling of insects, (*a*) attaching an additional bag or container to the butterfly net and (*b*) sorting the insects sizewar by means of a mechanical sorting box.

A series of ten group transmission experiments was devised by transferring all the abandoned 20 mesh to an inch cages from Noganur Reserved Forest, three healthy and one spiked sandal plants in pots were enclosed in each. Insect collections were made at dawn, dusk, and night with the improved type of net, classified into families, and released as detailed below :—

Cage number.	Date of start.	Natural orders released in each cage.	Number of insects released till 18th March 1937.
1	19th October 1936.	*Jassids*	312
2	Do.	*Pentatomids*	2,784
3	Do.	*Jassids and Pentatomids*	2,244
4	Do.	*Fulgorids*	179
5	Do.	*Jassids and Fulgorids*	136
6	Do.	*Pentatomids and Fulgorids* ..	1,945
7	Do.	*Coreidae, Pyrrhocoriedae,* and *Chrysomelidae.*	272
8	Do.	All except those released in cages 1 to 7 and 9 and 10.	1,517
9	Do.	*Membracidae* and *Curculionidae* ..	2,838
10	Do.	*Acrididae* and *Locustidae* ..	825

Sorting with the help of the box was found not very satisfactory and at the same time differentiation into families had to be done by hand. However handling the insects was minimized as the sorting was done both with the box and with the help of a glass tube.

No transmission however has taken place during the six months the experiment has been in operation though natural plants in the area manifested " spike " even in March 1937.

217. (vii) *Transmission experiments with individual species of insects.*—These experiments were carried out in duplicate both at Javalagiri and Denkanikota. At Denkanikota three healthy and one spiked sandal plants in pots were enclosed in 3 feet cube cages whereas at Javalagiri, four healthy plants were introduced into each cage but the cages were fixed up near naturally spiked sandal having plenty of diseased foliage. These spiked plants offered a branch or two in suitably low position so that these diseased branches could be inserted into the cages thus providing the source of infective material. This method has several advantages over the other method of providing spiked plants in pots inside the cages

as the latter do not long survive the mass feeding by insects. The diseased branch being a part of the big plant is capable of withstanding the attack of the insects much more successfully than the small pot plant. Transmission experiments in 25 cages of the 3 feet cube type and 40 cages enclosing single pots were done at Javalagiri by this method. At Denkanikota only 25 cages of 3 feet cube type were started. The type of species and insects introduced during the year are tabulated as follows :—

Locality.	Cage number.	Type number of insect.	Name of natural order.	Name of species.	Number of insects introduced.
Denkanikota ..	6	1	*Pentatomidae*	*Catacanthus incarnatus.*	183
	21	1	*Do.*	*Do.*	84
	3	21	*Jassidae*	*Jassus indicus*	289
	20	21	*Do.*	*Do.*	215
	4	23	*Fulgoridae*	*Sarima Sp.*	758
	16	23	*Do.*	*Do.*	768
	2	18	*Jassidae*	*Petalocephala nigrilinea.*	569
	17	18	*Do.*	*Do.*	645
	1	71	*Pentatomidae*	*Chrysocoris stockerus*	390
	22	71	*Do.*	*Do.*	398
	8	70	*Fulgoridae*	*Flata ferrugata*	156
	14	70	*Do.*	*Do.*	95
	9	92	*Do.*	*Dictyophara Sp.*	148
	10	19	*Jassidae*	*Acropona walkeri*	1,100
	11	19	*Do.*	*Do.*	1,208
	15	248	*Pentatomidae*	*Hotea curculionides*	167
	18	28	*Jassidae*	*Moonia albimaculata*	328
	23	28	*Do.*	*Do.*	595
	19	96	*Fulgoridae*	*Eurybrachys tomentosa*	289
	24	96	*Do.*	*Do.*	94
	5	29	*Jassidae*	*Neodartus acocephaloides.*	291
	13	29	*Do.*	*Do.*	235
	7	above 265 types		....	112
***Javalagiri* (3′ *cube cages*).**					
	1	28	*Jassidae*	*Moonia albimaculata*	48
	4	28	*Do.*	*Do.*	64
	2	19	*Do.*	*Acropona walkeri*	58
	5	19	*Do.*	*Do.*	64
	3	96	*Fulgoridae*	*Eurybrachys tomentosa*	48
	6	96	*Do.*	*Do.*	49
	7	71	*Pentatomidae*	*Chrysocoris stockerus*	46
	11	71	*Do.*	*Do.*	48
	8	23	*Fulgoridae*	*Sarima Sp.*	54
	13	23	*Do.*	*Do.*	34
	9	29	*Jassidae*	*Neodartus acocephaloides*	64
	12	29	*Do.*	*Do.*	42
	10	21	*Do.*	*Jassus indicus*	28
	14	21	*Do.*	*Do.*	28
	15	182	*Pentatomidae*	*Hotea nigrorufa*	86
	16	182	*Do.*	*Do.*	87
	17	1	*Do.*	*Catacanthus incarnatus*	76
	18	1	*Do.*	*Do.*	112
	19	248	*Do.*	*Hotea curculionides*	89
	20	248	*Do.*	*Do.*	132
	21	18	*Jassidae*	*Petalocephala nigrilinea.*	86
	22	18	*Do.*	*Do.*	113
	23	77	*Do.*	*Ledra mutica*	89
	24	77	*Do.*	*Do.*	97
	25	92	*Fulgoridae*	*Dictyophara Sp.*	98
***Javalagiri* (*Single pot cages*).**					
	1	1	*Pentatomidae*	*Catacanthus incarnatus*	786
	2	1	*Do.*	*Do.*	795
	3	1	*Do.*	*Do.*	648
	4	71	*Do.*	*Chrysocoris stockerus*	271
	5	71	*Do.*	*Do.*	285
	6	71	*Do.*	*Do.*	240
	7	248	*Do.*	*Hotea curculionides*	260
	8	248	*Do.*	*Do.*	295
	9	248	*Do.*	*Do.*	235
	10	29	*Jassidae*	*Neodartus acocephaloides.*	113
	11	29	*Do.*	*Do.*	128
	12	29	*Do.*	*Do.*	106
	13	92	*Fulgoridae*	*Dictyophara Sp.*	98
	14	92	*Do.*	*Do.*	85
	15	92	*Do.*	*Do.*	78
	16	21	*Jassidae*	*Jassus indicus*	121
	17	21	*Do.*	*Do.*	112

Locality.	Cage number.	Type number of insect.	Name of natural order.	Name of species.	Number of insects introduced.
Javalagiri (Single pot cages)—cont.					
	18	21	*Jassidae* ..	*Jassus indicus* ..	87
	19	70	*Fulgoridae* ..	*Flata ferrugata* ..	83
	20	70	*Do.* ..	*Do.* ..	55
	21	70	*Do.* ..	*Do.* ..	49
	22	203	*Do.* ..	*Salurmis marginellus* ..	46
	23	203	*Do.* ..	*Do.* ..	35
	24	203	*Do.* ..	*Do.* ..	35
	25	28	*Jassidae* ..	*Moonia albimaculata* ..	145
	26	28	*Do.* ..	*Do.* ..	125
	27	18	*Do.* ..	*Petalocephala nigrilinea.*	198
	28	18	*Do.* ..	*Do.*	178
	29	19	*Do.* ..	*Acropona walkeri* ..	124
	30	19	*Do.* ..	*Do.* ..	98
	31	23	*Fulgoridae* ..	*Sarima Sp.*	38
	32	23	*Do.* ..	*Do.*	48
	33	96	*Do.* ..	*Eurybrachys tomentosa* ..	268
	34	96	*Do.* ..	*Do.* ..	249
	35	77	*Jassidae* ..	*Ledra mutica*	28
	36	77	*Do.* ..	*Do.*	48
	37	20	*Do.* ..	*Bythoscopus indicus* ..	45
	38	20	*Do.* ..	*Do.* ..	58
	39	182	*Pentatomidae* ..	*Hotea nigrorufa* ..	278
	40	182	*Do.* ..	*Do.* ..	298

Even in these cages no transmission took place. The advice of the Imperial Entomologist was to go straight to this type of individual insect transmission work and reduce the period of exposure of plants inside cages to one month during 1937–38.

218. (viii) *Experiments with Aphids Thrips and Red spiders.*—The Imperial Entomologist suggested transmission experiments with Aphids, Thrips and Red spiders. All-cellaphane cages with a framework of wire netting were constructed and healthy sandal plants were enclosed in these.

The above insects as soon as they were caught were put in a sleeve which was tied on to spiked twigs. After 24 hours they were removed and introduced into the cellaphane cages as detailed below. Fresh spiked twigs were also introduced into the cages every evening to facilitate further feeding if necessary.

Date of start.	Cage number.	Name of insects.	Number of insects released till 31st March 1937.
27th October 1936 ..	3190	Aphids	154
Do. ..	90	Do.	186
Do. ..	2302	Do.	89
28th October 1936 ..	2405	Red spider	58
Do. ..	3281	Do.	76
30th October 1936 ..	341	Thrips	89
Do. ..	3674	Do.	78
Do. ..	854	Do.	76
20th October 1936 ..	3955	Aphids and Thrips ..	288

No transmission has so far been obtained but the mortality among Aphids and Red spiders was found high. Thrips thrived better when *Albizzia odoratissima* with spike like clusters were introduced as hosts to sandal.

219. (ix) *Food plant experiments.*—The experiment started in 1935–36 was continued during the year, the insects experimented with and the results obtained are tabulated :—

Insect type number.	Species of plants sleeved.	Suitable food plants found.	Number of experiments done.
1	Sandal, *Strychnos nux vomica, Cassia siamea, Mundulea suberosa, Cajanus indicus, Azadirachta indica, Ixora parviflora, Lantana, Albizzia amara, Pongamia glabra, Acacia suma, Zizyphus jujuba, Chloroxylon swietenia, Leucaena glauca, Grewia orientalis, Tephrosia candida, Dalbergia paniculata, Dodonea viscosa.*	Sandal, *Lantana, Ixora parviflora, Strychnos nux vomica.*	3
4	Sandal. *Mundulea suberosa, Strychnos nux-vomica, Breynia rhamnoides, Pongamia glabra,* Dhall, *Azadirachta indica, Dodonea viscosa, Erythroxylon monogynum Chloroxylon swietenia, Leucaena glauca, Albizzia amara.*	Dhall and *Dodonea viscosa.*	3
12	Sandal, *Acacia farnesiana, Mundulea suberosa.* Dhall, *Pongamia glabra, Breynia rhamnoides, Azadirachta indica, Strychnos nux vomica.*	*Mundulea suberosa* and Dhall.	2
71	Sandal, *Mundulea suberosa, Strychnos nux vomica, Cassia siamea, Ixora parviflora, Azadirachta indica, Cajanus indicus, Erythroxylon monogynum, Lantana, Albizzia amara, Zizyphus jujuba, Pongamia glabra,* and *Acacia suma, Leucaena glauca.*	*Breynia rhamnoides Ixora parviflora, and Azadirachta indica.*	2
24	*Mundulea suberosa, Strychnos nux vomica, Cassia siamea* Sandal, *Ixora parviflora, Azadirachta indica, Cajanus, indicus, Erythroxylon monogynum, Lantana Zizyphus jujuba, Albizzia amara, Pongamia glabra, Acacia suma, Leucaena glauca, Butea frondosa, Terminalia arjuna, Chloroxylon swietenia, Dalbergia latifolia, Tephrosia candida, Acacia farnesiana, Dalbergia paniculata, Albizzia lebbek, Pittosporum floribundum, Dodonea viscosa, Schleichera trijuga, Bambusa arundinacea, Argyreia cuneata, and Pithecolobium saman.*	*Mundulea suberosa, Cajanus indicus and Acacia suma.*	2
152	*Breynia rhamnoides, Pittosporum floribundum, Mundulea suberosa, Lantana,* Sandal, *Cajanus indicus, and Leucaena glauca.*	*Breynia rhamnoides,* Sandal and Dhall.	2

220. (x) *Specific Vector Experiments.*—These experiments were continued during the year by feeding individual species of insects on diseased twigs by enclosing them in sleeves for varying periods and then transferring them on to healthy sandal. The work done is detailed below :—

Types of insect.	Date of start.	Number of insects used for each period.	Period of feed of spike plants.	Date of defoliation of plants experimented.
4	13th November 1938.	10 insects ..	1 to 6 days at intervals of every 24 hours.	12th July 1936.
18	1st :eptember 1935.	Do. ..	1 to 15 days at intervals of every 24 hours.	Do.
19	20th September 1935.	Do. ..	1 to 9 days at intervals of every 24 hours.	Do.
24	17th November 1935.	Do. ..	1 to 15 days at intervals of every 24 hours.	Do.
96	11th November 1935.	Do. ..	1 to 11 days at intervals of every 24 hours.	Do.
238	18th December 1938.	Do. ..	1 to 9 days at intervals of every 24 hours.	8th November 1926.
	Repeated on 15th August 1936.	Do. ..	Do. do.	(8th November 1926.)
169	15th August 1936.	Do. ..	1 to 9 days at intervals of every 24 hours.	7th December 1936.

No transmission has occurred so far.

The plants subjected to this kind of attempted transmission were defoliated on the dates noted against each in the above statement, but all gave healthy shoots showing no infection.

III. Experiment to find out at what period of the day the infection occurs.

221. This experiment, started in 1935–36 was continued on the same lines up to August 1936 by exposing one set of plants from 6 a.m. to 6 p.m. and another set from 6 p.m. to 6 a.m. Infection occurred in both the sets. This was contrary to other experimental results and infection at dusk and dawn by both day and night fauna was considered a possible factor upsetting the experiment. It was therefore altered and three sets of 16 plants were introduced from 7th September 1936, one set being exposed from 5 a.m. to 8 a.m. and again from 5 p.m. to 8 p.m., the second set from 8 p.m. to 5 a.m. and the third set from 8 a.m. to 5 p.m., the hours being varied according to the time of sun set and sun rise. This is an attempt to confine possible infection to three periods, (*a*) dusk and dawn, (*b*) night, and (*c*) day. The total exposure period for each set of plants was fixed at two months, as the plants were frequently disturbed while changing the cages thereby reducing the chances for infection to a minimum. So far, one plant exposed from 8 p.m. to 5 a.m. from 7th September 1936 to 29th September 1936 showed spike thus giving at least one definite instance of infection at night.

IV. Experiment to find out whether pot plants are less susceptible to infection than non-potted plants.

222. The experiment started in 1935–36 was continued during the year and the results obtained are tabulated :—

Set number.	Nature of plants.	Number of plants, experimented.	Number manifested the disease so far.
A	Plants buried with pots right up to rim ..	100	..
B	Plants taken out of pots and planted	100	4
C	Plants with pots kept above ground	100	4

The arrangement is randomized in the order ABCCBA, etc. It is too early yet to be definite but indications are that the pots make no difference to infection incidence under field conditions.

V. Control operations.

223. These are dealt with under two heads, viz. :—

(1) Prevention.

(2) Cure.

(1) *Prevention of spike.*—Under prevention, the main work consisted in isolating a resistant strain of sandalwood.

(*a*) Acquired resistance.

224. (i) *As reported in* 1935–36, it has been definitely ascertained that sandal plants growing in association with different species of host plants possess different degrees of resistance to the

disease. A detailed list is given in the report for 1935–36. During the year, the following combinations were raised in the experimental garden :—

(1) *Acacia ferruginea.*
(2) *Acacia auriculiformis.*
(3) *Anacardium occidentale.*
(4) *Butea frondosa.*
(5) *Chloroxylon swietenia.*
(6) *Poinciana regia.*
(7) *Azadirachta indica.*
(8) *Cassia fistula.*
(9) *Semecarpus anacardium.*
(10) *Anona squamosa.*
(11) *Atalantia monophylla.*
(12) *Pithecolobium dulce.*
(13) *Miliusa eriocarpa.*
(14) *Strychnos potatorum.*
(15) *Carissa carandus.*
(16) *Pterocarpus marsupium.*
(17) *Olea glandulifera.*
(18) *Wrightia tinctoria.*
(19) *Leucaena glauca.*
(20) *Phyllanthus emblica.*
(21) *Eugenia jambolana.*
(22) *Cudrania javanensis.*
(23) *Linociera intermedia.*
(24) *Bambusa arundinacea.*
(25) *Ocimum sanctum.*
(26) *Zizuphus oenoplia.*
(27) *Toddalia aculeata.*
(28) *Cassia siamea.*
(29) *Strychnos nux-vomica.*

Of these, sandal plants growing in association with *Wrightia tinctoria* alone were big enough in size for artificial infection. Thirty combinations were infected and five of these got the disease indicating the percentage of resistance to be about 80. Those that did not manifest the disease have been re-infected to ascertain conclusive results.

225. (ii) *Mound experiments.*—The object of these experiments is to correlate the results of artificial infections of pot plants with those of natural infections in the field and also to compare the amount of resistance imparted by various hosts both under artificial and natural conditions. This experiment was started in 1931

and concluded in May 1936. Two hundred and fifty mounds $6' \times \frac{4' + 2'}{2} \times 3'$ in size were raised, and all combinations of hosts and sandal detailed below were introduced in a randomized way and left exposed to natural infection. All combinations of sandal with *Azadirachta indica, Strychnos nux vomica,* and *Somecarpus anacardium*, continued healthy. The degree of resistance imparted by other hosts is entered in the table below :—

Name of combinations.	Degree of resistance imparted. PER CENT.
Cassia siamea	80
Acacia ferruginea	80
Murraya koenigii .. .. }	75
Erythroxylon monogynum .. .. .. }	
Eugenia jambolana .. .. }	
Zizyphus jujuba .. .. }	60
Bambusa arundinacea .. .. .. }	
Jatropha cureas	50
Murraya exotica	45
Cassia montana	30
Terminalia arjuna	20
Dalbergia latifolia .. .. }	
Lantana .. .. }	0
Acacia farnesiana .. .. }	
Albizzia amara .. .. }	
Melia azadirach .. .. }	0
Mundulea suberosa .. .. }	

In May 1936, one combination of sandal with *Azadirachta indica* and one with *Strychnos nux-vomica*, showed spike. When these were uprooted and the root-systems examined, it was found that the root-systems of sandal plants had gone beyond the mounds and haustorized on various susceptible hosts. As continuance of the experiment would give misleading results, it was closed under the orders of the Provincial Silviculturist. The results obtained from this experiment are as follows :—

(*a*) The hosts that imparted the highest amount of resistance under artificial conditions behaved in the same way under field conditions;

(*b*) The different degrees of resistance imparted by other hosts were roughly the same both under artificial and field conditions.

(*c*) Quantitatively the virus introduced by natural agencies appears to be more potent.

226. (iii) *The results obtained under experiments* (*i*) *and* (*ii*) *were tested* in small plantations by opening four plots of one acre in extent and introducing sandal with all resistant types of hosts in two and with all susceptible types of hosts in the other two. These were instituted in 1930 and till 1935–36, the comparative spike incidence in the resistant and susceptible host plots was 1 to $3\frac{1}{2}$, but during the year, the ratio has gone down to 1 :1·6. Even here, it is to be remembered that plots of one acre are too small for plants of six to seven years of age when there is no protective belt introduced around them to eliminate marginal effects.

227. (iv) *These results are now applied* to field conditions in blocks of 5 acres, in the 60 acre plot at Noganur where the results obtained in items (i) to (iii) are introduced by the tending of the sandal. It is only two years since this operation was started and no spike infection has so far taken place within the area though there was spike closeby.

(*b*) Autogenic resistance.

228. (i) *Seventy-five plants tested to resist three artificial infections* were planted in the heavily spiked area at Javalagiri R.F. in 1932. Of these, as reported last year 42 died naturally and three got spiked including one that showed spike during the year. The remaining 30 plants are continuing healthy. Ten similar plants planted in Sanamavu R.F. as controls to these are perfectly healthy.

229. (ii) *Twelve sandal plants raised from four venated seeds* which gave seedlings possessing a better rootsystem and haustorizing capacity which were similar to those of plants that showed autogenic resistance were infected artificially during the year and four of these (i.e.), 33 1/3 per cent got the infection which indicates that the morphological difference in the venation of seeds has nothing to do with the innate resistance to ' spike '. Further work however is necessary, as the number tried is too small to be conclusive.

230. (iii) *Introduction of sub-lethal doses of infective material to induce immunity.*—Up to March 1937, four doses have been given to each of 14 sandal plants and all are continuing healthy so far.

231. (iv) *Prevention of infection by spraying with insect repellant sprays.*—As detailed in 1935–36, well known insect repellants were sprayed on healthy sandal in diseased areas once in a month and the results obtained are tabulated.

Locality.	Repellants used.	Date of start.	Number of plants sprayed.	Number of plants spiked till March 1937.	
					PER CENT.
Javalagiri ..	Lead arsenite	March 1935 ..	108	Nil.	0
	Copper arsenite	Do. ..	108	1	1
	Nicotine	Do. ..	108	3	3
	Derrisol	Do. ..	108	1	1
	Ci chona	Do. ..	108	Nil.	0
	Controls-Water	Do. ..	108	3	3
Aiyur ..	Lead arsenite	August 1933 ..	50	3	6
	Copper arsenite	Do. ..	50	4	8
	Nicotine	Do. ..	50	6	12
	Cinchona	Do. ..	50	5	10
	Asafoetida	Do. ..	50	3	6
	Controls-Water	Do. ..	50	11	22

The earliest spraying experiments were started in August 1933 and the spike incidence recorded above is the total incidence of infection over a period of three years and seven months. This result as compared with the incidence among the controls and the normal annual incidence in other spike areas of the division is significant.

The Imperial Entomologist inspected these experiments and gave his opinion as follows :—" Present indications are that the vector is a sap sucker and therefore the spray should be a mechanical film and not a stomach poison." The effect of the spray on the insects was advised to be tested by sleeving different species of insects on sprayed material.

232. (v) *Lopping and spraying*.—The experiments initiated in Noganur R.F. in 1935–36 to test whether re-infection of lopped healthy trees in newly affected localities could be prevented by spraying them with a composite spray of lead and copper arsenites were continued during the year. So far, re-infection appears to have been prevented by such sprays as six trees among the unsprayed controls showed spike up to March 1937.

The Imperial Entomologist was in favour of continuing this experiment periodically recording and listing the types of scars which occurred on the sprayed branches.

The experiment was duplicated in Denkanikota Reserved Forest from September 1935. The results are tabulated :—

Set number.	Nature of treatment.	Date of start.	Number of trees sprayed.	Number spiked with date.	
				Month.	Number spiked.
A	Sprayed every month ..	September 1935.	250	Nil.	
B	Do. in alternate months.	Do.	250	Nil.	
C	Do. only in effective seasons.	Do.	250	March 1937—1.	
D	Not sprayed—Controls ..	Do.	250	November 1936—1.	

The results indicate that spraying only in the effective seasons is not enough and the Imperial Entomologist was also of this opinion and advised spraying all through the year.

233. (vi) *Injection experiments*.—Introduction of minute doses of certain elements which are usually found in healthy plants and whose presence in the plant body either repels insect vectors or neutralises the virus introduced by insects in the plant itself were injected into healthy sandal plants as detailed below :—

Date of start.	Nature of chemical.	Name of chemical.	Proportion of dose.	Number of plants injected.	Number spiked till December 1936.	Remarks.
						PEB CENT.
May 1935..	Resistance builders.	Aluminium sulphate.	1: 1000	50	6	12
Do. ..	Do.	Zinc sulphate ..	1 : 1000	50	8	16
Do. ..	Do.	Manganese chloride.	1: 1000	50	4	8
Do. ..	Insect repeilants.	Pyridine ..	1 : 10000	50	5	10
Do. ..	Do.	Strychnine ..	1 : 10000	50	6	12
Do. ..	Do.	Nicotine ..	1 : 10000	50	12	24
January 1936.	Resistance builders.	Formalin ..	1 : 100	50	3	6
May 1935.	Water-controls ..	....	..	50	4	8
Do.	Ordinary controls.	....	..	50	13	26

As the results were not significant, these were discussed by the Conservator and the Provincial Silviculturist and it was decided to increase the dosage gradually to their possible maximum which could be detected by the withering of tender twigs.

Accordingly from December 1936, the dosage was doubled and it is still too early to judge results.

(2) *Cure and control of spike.*

234. The control operations detailed last year were applied to new localities during the year also and the results of success obtained so far are as follows.

235. (i) *Noganur Reserved Forest.*—(*a*) *Spike area No.* 1.—This lies in the eastern half of Noganur Reserved Forest 1½ miles as the crow flies from the nearest spike area. Spike disease was observed on 12 trees on 25th June 1934 and on 17 trees on 21st December 1934. All the 29 spiked trees were girdled and treated with Atlas.

The area was demarcated and all apparently healthy trees amounting to 3,170 in the area were lopped. Five trees out of 3,170 showed the disease up to March 1935. In March 1935, the lopped trees were taken up for carrying out spraying experiments.

(*b*) *Spike area No.* 2.—On 30th June 1934, a solitary spiked tree was observed in a different locality. It was treated and killed with Atlas. All apparently healthy trees around the area to a distance of 100 feet were lopped.

Only one tree out of 62 lopped sandal trees showed the disease and the locality has been free from spike since, (2¾ years).

(*c*) *Spike area No.* 3, *near the Noganur* 60-*acre plot.*—Two localities one containing five spiked trees and the other containing three trees, the intervening distance between them being a furlong were found in May and June 1936 about a furlong distance from the Noganur 60-acre plot. The two localities were treated as one and both the areas were jointly demarcated with a 300 feet belt all round and 1,804 apparently healthy trees were lopped.

So far no spike has appeared in the area or outside the demarcated limits.

236. (ii) *Denkanikota R.F.*—(*a*) *Fuel coupe spike area.*—This lies about four furlongs east of the Denkanikota R.F. spike area and only one tree was found affected in December 1934. The spiked tree was girdled and treated with Atlas and all apparently healthy trees amounting to 81 within a radius of 300 feet were lopped.

None of the lopped trees showed the disease (2¼ years) and there has been no further spread.

(*b*) *Gudigunta spike area.*—This is situated about two miles as the crow flies from the nearest spike area. A group of seven trees was found affected. They were carefully uprooted and removed. A belt of 100 yards all round the infected group was demarcated and all apparently healthy trees and saplings amounting to 68 were lopped in June 1935.

No recrudescence has occurred.

(*c*) *Jogvenka area.*—One tree 19 inches in girth was found spiked on 3rd October 1935. This was immediately killed with

Atlas, the area was demarcated by a 100 yards belt all round and all apparently healthy trees and saplings amounting to 88 were lopped in October 1935. No spread has occurred.

(*d*) *Denkanikota* 1936 *spike area.*—This lies over 2 miles as the crow flies from the nearest spike area. Spike disease was noticed on 10th October 1936 and four trees were found affected. They were girdled and treated with Atlas. The area was demarcated taking a belt of 100 feet all round and all apparently healthy trees amounting to 73 were lopped in October 1936.

None of the lopped trees has shown the disease so far.

(*e*) *Devasthanam Kothanur Patta land spike area.*—This locality is situated about two miles North of Denkanikota R.F. spike area right in the middle of patta lands. Eleven trees were found spiked in January 1936. All these were girdled and treated with Atlas.

All the apparently healthy trees amounting to 190 within a radius of 100 yards all round the spiked locality were lopped after obtaining the consent of the pattadar. Seventeen of the lopped trees showed the disease and these were killed by Atlas treatment.

No spread outside the demarcated area has occurred so far.

237. (iii) *Manchi unreserve* 1936 *spike areas.*—Two isolated patches were found attacked in May and June 1936. One had 8 spiked trees at about four furlongs from the spike area in Manchi " B " and the other 7 spike trees about two furlongs from the spike area in " A." On 24th July 1936, two more trees were found spiked in the spike area near Manchi " B " and one tree in the area near " A." All these trees were girdled and treated with Atlas.

All apparently healthy trees and saplings amounting to 872 in the new spike area near " B " (Area No. 1) and 102 in the new spike area near " A " (Area No. 2) were lopped in July 1936.

Three of the lopped trees in area No. 1, and 3 of the lopped trees in area No. 2 have shown the disease so far.

238. (iv) *Rangasandiram spike area.*—This area lies about two miles N.N.E. of Noganur spike area and one and a half miles to the west of Denkanikota town.

Six sandal trees were found spiked on 18th November 1936. They were girdled and treated with Atlas and all apparently healthy trees amounting to 90 were lopped.

None of the lopped trees have shown the disease yet.

239. (v) *Gandaganahalli patta land spike area.*—Spike occurrence in this locality in a patta land was noticed on 18th November 1936. This area is about two miles from Rangasandiram spike area and one and a half miles from Noganur reserve forest spike area.

Four sandal trees were found spiked and also a stump of 12″ was found spiked. These were killed with Atlas solution, and all apparently healthy trees lopped.

None of the lopped trees have manifested the disease so far.

240. (vi) *Old areas.*—(*a*) In Denkanikota and Manchi spike areas, large blocks of about 300 acres in extent in each locality have been subjected to control operations since the beginning of 1933 in Denkanikota and April 1932 in Manchi—the date of outbreak of spike in Denkanikota being 20th February 1926 and Manchi January 1931. All spiked trees were killed with Atlas and all apparently healthy sandal trees amounting to 18,612 were lopped to bring out the disease symptoms, if any. Those that manifested the disease were also killed with Atlas.

It is satisfactory to note that in this very large scale experiment the disease has confined itself to the originally demarcated limits though we have not been able completely to stop the disease within the affected area.

241. (*b*) *Kodagarai area.*—A third area (Kodagarai area) in which only treating of spiked trees with Atlas was carried out till April 1935 was subjected to control operations, as the spread in the area was found to be more than five times when compared with the original extent. This area was inspected in June 1936 and the disease was found to have spread to a small extent outside the demarcated limits as the work within the area was not properly carried out (i.e.), many of the spiked trees were left untreated. These defects were rectified and a belt of 300 feet all round the area was cut and all apparently healthy sandal trees within the belt were also lopped.

Now it is satisfactory to note that the disease has not spread outside these limits in this area also.

242. The results of control operations both in the newly affected localities and old areas indicate—

(i) that the control measures are fully effective in the case of new outbreaks where only a few trees are found infected; and

(ii) in the case of large blocks where the disease has been allowed to spread for some time uncontrolled, the effect of the control operations is to confine the disease to the original limits of the outbreak.

VI. Technique to find out if an area is susceptible to infection or not and how far the environmental factors influence the resistance or susceptibility.

243. The results of experiments detailed in the last year indicated that spike infection appears to have been influenced by ecological factors.

An experiment was started last year to test the above results by raising sandal plants from different areas and grafting. The

results of experiments in pots in 1935–36 indicated that there is apparently some correlation between the results obtained under controlled conditions and those obtained under field conditions.

As the number of plants experimented with in pots was considered insufficient, 100 sandal plants brought from Kenilworth Castle area, Thalli reserve forest and Samayeri reserve forest area were stumped and planted in pots containing soil brought from the respective areas, with *Acacia farnesiana* or *Mundulea suberosa* hosts during the year. These are not yet big enough for grafting.

VII. General.

244. (i) One hundred and eighty-one types of insects out of the 265 types which produced the disease in the mass infection cages have been sent to the Forest Entomologist, Dehra Dun, for identification.

(ii) The periodical collections of insects carried out in Pane Reserved Forest, Thalli Reserved Forest, and Denkanikota field crops have been sent to the Forest Entomologist to assist him in preparing a priority list of suspects by distribution in healthy and diseased areas.

(iii) Spiked specimens of *Santalum album*, both pressed and preserved in formalin, were supplied to the District Forest Officers, Chittoor, Salem Central, and Salem South divisions, during the year.

Summary.

245. The following are the main results of the spike investigation during the year :—

(i) Sandal plants can be saved from spike infection by caging with cloth and probably by wire-netting of 20 meshes to an inch.

(ii) The cages of different meshes erected in Noganur R.F., indicated that many large-bodied and long-legged insects are unlikely to be vectors and coccids, first instar caterpillars, and probably also aphids, thrips and red spider and similar forms are unlikely to be vectors, and (*b*) that the size of the vector is probably between 1/10 inch and $\frac{1}{2}$ inch.

(iii) The platform experiments during the year have indicated two probable months of infection, viz., August and October, and that an exposure of one month is sufficient to permit infection.

(iv) One definite instance of infection during night time has been recorded during the year thus supporting the indication already obtained that night fauna appears to be generally responsible for transmission.

(v) Individual transmission experiments with the following species, viz., *Catacanthus incarnatus*, *Jassus indicus*, *Sarima Sp.*, *Petalocephala nigrilinea*, *Chrysocoris stockerus*, *Flata ferrugata*, *Dictyophara Sp.*, *Acropona walkeri*, *Hotea curculionides*, *Moonia albimaculata*, *Eurybrachys tomentosa*, *Neodartus acocephaloides*, *Hotea nigrorufa*, *Ledra mutica*, *Salurmis marginellus*, *Bythoscopus indicus* are in progress and so far no transmission has occurred.

(vi) Transmission experiments with Aphids, Thrips and Red spider are in progress but no results are yet available.

(vii) More evidence regarding the occurrence of spike in close proximity to cultivated lands in which both field crops and other indigeneous herbs suffered from virus diseases of other types was recorded in newly infected areas.

(viii) Resistance to varying extent is built up in sandal associated with various hosts and quantitative evidence of the different degrees of resistance imparted by each host has been obtained.

(ix) Composite sprays of lead and copper arsenites appear to ward off the vectors and results during the year indicate that spraying only in the effective seasons is not enough to prevent infection and that spraying should be done throughout the year.

(x) Anti-spike operations carried out indicate that the control measures are fully effective in the case of areas where only a few trees are found infected and that in the case of large blocks where the disease has been allowed to spread for some time uncontrolled, the effect of the control operations is in confining the disease to the original limits of the outbreak.

(xi) Experiments to isolate a resistant strain and to find out whether the comparative resistance acquired by sandal through host plants is transferable from parent to progeny are in progress.

(xii) Attempted immunization of plants by sub-lethal doses is in progress.

(xiii) Artificial infection by grafting and natural infections in the field are more or less comparable. Quantitatively the virus introduced by natural agencies appears to be more potent.

Deductions from experiments on sandal insects in Salem, Bangalore, and elsewhere in Mysore, by Dr. C. F. C. Beeson, M.A., D.Sc., I.F.S., F.E.S., Forest Entomologist, Dehra Dun.

246. (1) Spike is an insect-borne disease.

(2) Disease is excluded from a plant by barriers of cloth and of wiregauze 20 meshes to the inch; it is not excluded by wire-netting of 2 meshes to the inch.

(3) Small wind-borne insects penetrate 20 mesh wire gauze hence coccids, and first instar caterpillars, and probably also aphids, thrips, red spider and similar forms are unlikely to be vectors.

(4) The vector passes an aperture of half an inch, hence many large-bodied and long-legged species are unlikely to be vectors.

(5) The vector frequents sandal foliage during the period dusk to dawn.

(6) The vector is probably either,

(*a*) an uncommon species, or

(*b*) an uncommon strain of a common species.

(7) The vector is active as a transmitting agent at two seasons of the year, February to May and July to December but population surveys show that the incidence of sandal sap-suckers falls very low in June.

(8) Artificial transmission experiments have failed to produce spike but suspicious conditions have been produced by *Moonia* (1933 and 1934) and by *lantana* aphids.

(9) The common factors in these experiments were either,

(*a*) confinement with spike and immediately after with healthy plants, or

(*b*) confinement with spike and immediately after with healthy and spike plants, and long period of exposure.

There was considerable variation in the nature and size of cage and in pruning or other after treatment.

(10) Spike has been produced in two cases in large cages by releasing wild insects directly after collection.

(11) An exposure of one month is sufficient to permit infection.

(*b*) *Periodicity of height growth.*

247. *General.*—Measurements were taken weekly at all centres for a number of species to determine the active growing periods and resting periods of the young trees.

Results during the year show the following.

248. (A) *Evergreen forest*—(i) *Chandanathode.*—All species grew throughout the year very slowly and steadily but with an appreciably increased rate during April and May and again in September, i.e., just before and just after the South-West monsoon.

Species.—Hopea parviflora, Dysoxylum malabaricum, Dipterocarpus indicus, Cedrela toona and Swietenia macrophylla.

(ii) *Karianshola.*—All species grew slowly and steadily during the year with the exception of *Swietenia macrophylla*, which showed a sudden acceleration of growth in March/April which however was not maintained.

Species.—Artocarpus hirsuta, Cedrela toona, Dipterocarpus indicus, Hopea parviflora, Mesua ferrea and *Swietenia macrophylla.*

249. (B) *Mixed decuduous forest*—(i) *Nilambur.*—Teak and Andaman Padauk (*Pterocarpus dalbergioides*) had a longer growing season than usual for they grew steadily in height from the middle of April 1936 until the end of January 1937 when they started their hot weather rest.

(ii) *Kannoth.*—All species grew steadily throughout the year without any marked rest periods. The growth of teak however was most active from the middle of May to the end of November 1936.

Species.—Artocarpus hirsuta, Dalbergia latifolia, Pterocarpus marsupium, Pterocarpus dalbergioides, Swietenia, macrophylla, Tectona grandis and *Terminalia crenulata.*

(iii) *Begur.*—All species started growing after their rest period about the end of March 1936 and this growing season lasted until the end of November when they again started a rest period. The growth of young *Bambusa arundinacea* and *Dendrocalamus* strictus (one year old) was very rapid in September/October/November.

Species.--Artocarpus hirsuta, Bambusa arundinacea, Castanospermum australe, Chloroxylon swietenia, Dalbergia latifolia, Dendrocalamus strictus, Pterocarpus marsupium, Schleichera trijuga, Swietenia macrophylla, Tectona grandis and *Terminalia crenulata.*

(iv) *Dhoni.*—All species grew rapidly from April/May 1936 until mid-January 1937 when although they did not rest completely the rate of growth slowed down very considerably.

Species.—Dalbergia latifolia, Pterocarpus marsupium, Swietenia macrophylla, Tectona grandis, Terminalia crenulata and *Xylia xylocarpa.*

(v) *Topslip.*—The period of active growth of all species was very marked and lasted from the end of March until the end of November 1936.

Species.—Dalbergia latifolia, Pterocarpus marsupium, Tectona grandis, Terminalia crenulata and *Xylia xylocarpa.*

250. (C) *Dry fuel forests—Emmanur.*—All species grew slowly but steadily throughout the year with the exception of *Prosopis juliflora* and *Acacia auriculiformis* which showed marked increases in their growth rate in the period October/November/December 1936.

Species.—Acacia auriculiformis, Acacia ferruginea, Acacia sundra, Albizzia amara, Anacardium occidentale, Azadirachta indica, Cassia siamea and *Prosopis juliflora.*

(c) *Weeds.*

Lantana eradication. I. ~~Silvicultural methods~~.

(a) *Introduction of Bambusa arundinacea and Dendrocalamus strictus under Lantana.*

251. The experiments in underplanting dense *Lantana* with *Bambusa arundinacea* and *Dendrocalamus strictus* in North Salem division which were started in 1933 were continued during the year. These experiments have already been reported in previous annual reports and at present one can only say that they show great promise and cost about Rs. 8 to Rs. 10 per acre.

252. In order to test the capability of *Bambusa arundinacea* to suppress *Lantana* in mixed deciduous forest of good quality four experiments have been started. (Experimental Plot 32, Wynad Division, Experimental Plot 67, South Coimbatore Division, and Experimental Plot 150-A and B in Palghat Division.) In each experiment, plots of about 1 acre each were selected where *Lantana* had come in and almost completely defeated the natural forest. *Bambusa* was established by coolies crawling under this dense *Lantana* growth and planting one year old transplants and rhizomes at 15′ × 15′ espacement in alternate lines. No cutting of *Lantana* at all was done and it was as little disturbed as possible. At the end of the first year the establishment is as follows :—

Division.	Experimental plot number.	Transplants.		Rhizomes.	
		Survival per cent.	Mean height in inches.	Survival Per cent.	Mean height in inches.
Wynaad	32	79	31·10	40	15·15
Coimbatore South	67	29	8·40	57	14·18
Palghat	150 A	85	24·40	71	28·70
	150 B	76	15·80	91	26·60
Average ..		67	19·93	65	21·16

The above figures show that there has been very little difference in survival per cent or mean height growth between the transplants and rhizomes.

(b) *Regeneration in Lantana destroyed areas.*

253. (i) *Noganur 2-acre plot.*—*Lantana* growth in this plot was cut between 27th April 1936 and 7th May 1936 and burned between 17th May 1936 and 21st May 1936. The regrowth was sprayed with sodium chlorate solution in August 1936. It was planted with *Cassia siamea* stumps 1½ years old in early October 1936 and results in March 1937 show 90 per cent success. It remains to be seen whether this plot will be reinvaded by *Lantana* before the *Cassia siamea* is high enough and dense enough to resist it.

(ii) *Noganur 4-acre plot.*—*Lantana* was uprooted and burned in this area and *Cassia siamea* sown on 1st June 1934. At present the plot is well stocked with plants, the average height of which is 6 feet.

(iii) *Javalagiri 2½-acre plot.*—*Lantana* was uprooted and burned in this area and *Cassia siamea* sown in May 1933. The plot is fully stocked with plants, the average height of which is 18 feet. In 1936 a thinning was done and 785 stems removed. In spite of this the area is overstocked and further thinning is required.

II. Chemical methods—Spraying with sodium chlorate.

254. This method and its results were discussed in last year's annual report, paragraph 209, and it suffices to say that further large scale experiments this year have shown that the method is completely successful at a cost of Rs. 6 per acre even though three sprayings are sometimes necessary (density of *Lantana* 10,000 stems per acre).

In addition to the above an experiment over 2 acres was also done in North Salem division in which *Lantana* of a density of 6,000 stems to the acre was cut and burned in mid-May 1936. By August 1936 the regrowth from collar shoots was complete and this was sprayed with sodium chlorate solution.

A second spraying was found necessary and done at the end of November 1936. Inspection in January 1937 showed that 25 per cent of the stems which were sprayed in November were still green though they had produced no foliage. It is therefore possible that a third spraying may be necessary. This experiment has so far cost Rs. 9–8–0 per acre and therefore indicates that eradication by spraying alone is the cheapest and most effective method we have yet tried.

Further extensive experiments to find out the most effective and cheapest concentration of solution and spreader to use in the first, second and third sprayings have been initiated but it is too early yet to give results.

It is to be noted that eradication of *Lantana* by underplanting with *Bamboos* although it takes a longer time for the pest to disappear is cheaper than spraying and then planting the area with a species like *Cassia siamea*.

255. *Climber eradication by poisoning.*—Experiments in this subject were continued. The poison was made up in three strengths—

(A) Strong. 1 lb. of As_2O_3 in ¾ gallon of solution,

(B) Medium. 1 lb. of As_2O_3 in 3 gallons of solution,

(C) Weak. 1 lb. of As_2O_3 in 12 gallons of solution,

and was applied in two ways, by girdling the climber and painting the poison on the girdle and by pouring the poison into a frill made in the stem (for details of making up the poison, etc.—vide the Annual Report of 1934–35, paragraphs 223 to 226).

In the experiment with *Zizyphus œnoplia* some climbers produced shoots from the base with the first rains after the poisoning but these shoots turned out to be feeble and most of them

died in the following hot weather. In Experimental Plot No. 14, Coimbatore North Division, *Pterolobium indicum* was poisoned on 28th March 1935 and this also produced basal shoots with approximately 40 per cent of the climbers treated and these shoots have most of them persisted. In consequence the experiment was repeated in Experimental Plot No. 17, Coimbatore North Division, with the same species. The poisoning was done on 30th January 1936 and by the middle of May 1936 only 10 per cent had produced basal shoots, but by December 1936 this percentage had increased to 60.

From the experience gained so far the indication is that a poison intermediate in strength between the strong and the medium solutions and applied after girdling very early in the hot weather, gives the best results. The cost of such an operation is approximately annas 4 per 100 climbers treated. It does not appear to be very effective however with *Pterolobium indicum*.

256. *Strobilanthes eradication.*—Experimental Plots 1, 2 and 22, Wynaad division, have as their object the eradication of *Strobilanthes*. The first two of these plots were initiated in 1932, one year after the *Strobilanthes* flowering and the last one in 1934, i.e., three years after. The following four treatments were applied; (A) control—nothing done, (B) cutting above the aerial root, (C) cutting flush with the ground, (D) pulling out by hand. So far practically no plants have appeared in the treated plots. The species is suspected to be *Strobilanthes reticulatus* but this can only be confirmed at the next flowering.

257. *Attempted suppression of Eupatorium in the Nilgiris.*—The weed *Eupatorium* is seriously invading grazing grounds in the Nilgiris. Kikiyu grass has been introduced in a series of plots after pulling up the *Eupatorium* to see whether the grass so established will keep out the weed. The grass is now well established and its " runners " have penetrated well into the *Eupatorium*, but a few plants of the weed have appeared in the grass but look sickly. The struggle between the two is still in progress and after three years the method looks promising. In consequence a large scale experiment is being started this year to endeavour to get a reliable estimate of the costs of such work. In addition it is to be noted that the *Eupatorium* thus uprooted is a good base for making ' compost ' for nursery manure.

258. *Improvement of grazing areas—Kikiyu grass.*—In the last few years some interesting experiments have been done in Kollegal division in the improvement and creation of grazing areas by the introduction of Kikiyu grass. The experiments all show that this grass can be successfully raised very easily but the District Forest Officer reports that so far no villager has taken any interest at all in the experiments nor does there appear any prospect of his doing so in the future.

This appears to be a case where propaganda by both the Forest and Agriculture departments is needed.

II. WORKING PLANS AND STATISTICS.

(i) Working Plans.

259. The Provincial Silviculturist continued to be in touch through the Conservator of Forests, Working Plans Circle with the Working Plans Officers in the various districts. He was largely consulted with regard to proposed prescriptions on silvicultural matters and statistical work. The experience gained and the results obtained in this branch were availed of by the Working Plans Officers and District Forest Officers.

260. The following statement shows the working plans under preparation in the Working Plans Circle at the beginning of the year under review, those completed during the year, and the new ones undertaken :—

Number of Working Plans Party.	Working Plans under preparation at the beginning of the year.	Working Plans completed during the year.	New Working Plans commenced during the year.	Remarks.
I	West Vellore Division.	West Vellore* ..	Nilambur Division.	* Field work completed but writing up of the plan still pending at the close of the year.
II	South Cuddapah Division.	South Cuddapah* ..	Anantapur ..	*Do.
III	Palghat Division—(Walayar, Bolampatty and Thadagam Valleys).	Palghat Division—(Walayar, Bolampatty and Thadagam Valleys).	Wynaad† ..	† Field work will be taken up in June 1937.
IV	The Nilgiris Division.‡	..	..	‡ Completed in April 1937 and working plan for Kurnool East has been taken up thereafter.
V	The Upper Godavari Division.	..	..	Field work completed and the writing of the plan by the Working Plan Officer which is in progress is expected to be completed in June 1937.

The Working Plan for the Cuddapah North division was sanctioned during the year, and that of Salem North division after the close of the year.

261. The cost of the preparation of Palghat division (Walayar, Bolampatty and Thadagam Valleys) Working Plan is Re. 0–6–6 per acre.

(ii) Yield, Volume, and Form Factor Tables.

262. *Sample plots.*—At the beginning of the year 10 " Sal " sample plots in Ganjam division were handed over to the new Orissa Province. The remaining 68 sample plots representing 16 species in 8 districts were maintained and their condition verified. Seven teak sample plots in the Wynaad were remeasured. In most cases standing sample tree measurement was done using climbers and a locally-made swing seat and tackle as the Dehra Dun extensible ladder as an aid to such measurements had been found not suitable to Madras conditions.

263. *Tree increment plots.*—Twenty-one tree increment plots representing 11 species in six districts were maintained. Of these, 17 plots are linear having base lines totalling 17·5 miles and the remaining four plots are compact having a total area of 14·9 acres.

264. *Permanent Preservation Plots.*—The 18 plots listed in paragraph 225 of last year's report were maintained. The initial work having been done, the situation is now being considered and it will shortly be decided what further plots, if any, are required.

III. MISCELLANEOUS.

TOURS, RECORDS AND STAFF.

265. *Tours.*—The Provincial Silviculturist toured for 201 days during the year under report. The Assistant Silviculturist spent only 117 days on tour as most of his work is in headquarters such as ledgering, computing and general statistical work.

266. In accordance with item 1 (*a*)–(*c*) of resolution No. 3 of the Dehra Dun Silvicultural Conference held in 1934 and under the sanction of the Government of Madras Miscellaneous No. 1851, dated 20th October 1936, the Provincial Silviculturist toured in East Bengal with the Central Silviculturist, Dehra Dun, and the Bengal Silviculturist from 13th November to 19th December 1936. The object of the tour was the study of the regeneration of evergreens and Mahogany. A detailed note on the tour describing the works seen, the conclusions to be drawn from the work and its application to the Madras Presidency was prepared and submitted to the Chief Conservator of Forests, Madras.

267. The spike Research Works in North Salem division were inspected during the year with the Forest Entomologist, Dehra Dun, who kindly summarized the work done so far and made valuable suggestions for future work.

268. Information on the cultivation in South India of the "Green wattle" (*Acacia decurrens*) was collected by the Assistant Silviculturist for comparison with similar information received from South Africa.

The "Standing Orders for the detection and control of the spike disease of sandal" referred to in paragraph 228 (*a*) of last year's report were sanctioned by Government during the year.

The Provincial Silviculturist has been selected by the Chief Conservator of Forests, Madras, to attend the "Research Demonstration Course" at Dehra Dun, in October 1937.

The three Research Range offices of the division were inspected during the year.

269. *Records.*—The specific and general ledger files now number 429 and 152, respectively; 11 new specific ledger files and 3 new general ledger files having been opened during the year. The work of subdividing the bulkier ledger files and condensing and publishing in pamphlet form the available information on some of the more important subjects has not yet been started owing to lack of time and staff. It is hoped that this work will be started soon.

The half-yearly inspection of the ledger files have been made by the Conservator of Forests, Working Plans Circle.

270. Seventeen new Experimental Plots and 254 new Experimental Garden experiments have been opened and 13 Experimental plots and 112 Experimental Garden experiments closed during the year. In consequence 76 Experimental plots and 287 Experimental Garden experiments were open at the close of the year.

271. Twenty-three photographs were added to the collection during the year, the total number of photographs now ledgered being 507 under specific ledger files and 273 under general ledger files.

272. *Staff.*—The Extra Assistant Conservator of Forests remained throughout the year in the division as Assistant. The subordinate staff now consists of 3 Research Rangers, 10 Foresters (including 1 on long leave) and 1 Forest Guard. M.R.Ry. J. D. David, Ranger, grade I, retired from service during the year.

The office staff now consists of 1 head clerk, 2 clerks and 1 typist.

273. *Discipline.*—The general discipline of the staff was satisfactory.

OOTACAMUND,
2nd *June* 1937.

A. L. GRIFFITH,
Provincial Silviculturist.

PART II.

EXPERIMENTAL DATA.

274. *Rainfall in inches and number of rainy days* (vide paragraph 4)—

Locality.	April 1936.	May 1936.	June 1936.	July 1936.	August 1936.	September 1936.	October 1936.	November 1936.	December 1936.	January 1937.	February 1937.	March 1937.	April 1937.	May 1937.	For the year from 1st April 1936 to 1st April 1937.	Average of years.	
																INCHES.	YEARS.
Evergreen forests.																	
Topslip (Karianshola) ..	0·20	5·10	14·15	13·14	6·80	8·40	5·80	16·20	3·60	..	0·30	3·80	5·65	1·00	77·49	62·28	13
	1	12	16	21	14	9	8	8	15		2	4	8	2	110		
Chandanathode ..	1·20	16·40	66·00	81·40	49·60	17·90	14·50	6·30	0·10	..	..	0·60	5·30	7·30	254·00	153·37	20
	5	17	27	30	26	21	12	10	1			2	9	14	151	144	
Mixed deciduous forests.																	
Nilambur	2·01	13·95	26·84	28·37	13·26	12·18	6·57	6·90	0·05	..	0·01	1·69	3·48	3·66	111·83	112·55	62
	4	11	28	27	21	15	14	16	1		1	4	8	10	142	112	
Begur	2·13	6·13	15·07	13·48	10·00	6·00	4·16	1·77	0·32	..	0·78	2·07	2·00	3·40	61·91	72·98	20
	5	18	27	28	24	18	8	11	1		2	4	11	10	146	74	
Kannoth	0·56	9·82	38·16	40·97	28·02	11·67	10·18	3·94	..	..	..	0·03	5·24	4·06	143·35	73·31	18
	3	15	29	29	28	18	16	11				1	9	10	150	137	
Dhoni	0·14	10·64	22·25	26·18	18·82	15·67	9·25	4·76	..	..	..	1·65	6·28	0·76	109·36	105·38	10
	1	12	27	26	23	15	13	12				5	8	4	134		
Walayar	0·10	1·90	13·30	7·00	6·90	1·50	7·40	3·10	0·40	..	0·10	0·50	1·80	1·80	42·20	53·55	17
	1	6	17	17	14	6	11	6	1		1	2	5	2	82		
Dry fuel forests.																	
Emmanur	0·39	2·84	2·40	1·54	1·78	4·39	6·63	5·38	0·35	..	2·56	2·41	4·54	3·08	30·67	28·93	1
	2	9	8	6	4	12	9	15	4		5	5	10	15	79	79	
Satyamangalam	0·98	2·61	2·04	1·05	1·48	5·57	6·76	2·63	1·90	..	2·68	0·33	4·02	2·56	28·03	29·86	43
	4	6	7	4	5	10	10	13	2		2	2	8	12	65	55	
Denkanikota	1·06	4·92	2·30	4·16	1·80	8·72	2·91	5·87	..	0·18	0·95	1·16	9·19	10·30	34·02	33·49	14
	2	8	8	9	7	12	8	12		1	3	2	12	11	72	70	
High Elevation Forests.																	
Jacko's Nullah	..	..	12·34	6·18	3·68	3·85	3·26	3·81	0.10	0·50	·54	1·19	5·82	3·08	44·35*	..	..
			16	24	14	14	12	13	1	1	4	6	15	12	132		
Windy corner (Yemakal) ..	0·96	5·92	8·38	6·16	3·86	3·12	3·38	3·60	0·32	0·07	0·53	1·11	4·09	3·14	37·41	..	..
	7	18	22	28	25	21	23	16	7	2	10	10	17	14	189		

* Total from June 1st, 1936 to May 1st, 1937.

Seed storage (vide paragraph 34).

275. Tests made at intervals with seed from the same sample gave the following indications of the length of time the seed remains fertile. Previous years' results are included in the table.

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Acacia auriculiformis.	(1) Stoppered bottle.	22	7	No falling off up to 9 months.
	(2) Earthen pot..	22	7	
	(3) Gunny bag ..	22	7	
	(4) Air-tight tins.	24	4	No falling off up to 8 months.
Acacia cyanophylla.	(1) Stoppered bottle.	21	6	No falling off up to 8 months.
	(2) Earthen pot..	21	6	
	(3) Gunny bag ..	21	6	
	(4) Air-tight tins.	28	8	Seed 10 months old only slightly less fertile than fresh seed.
Acacia ferruginea ..	(1) Stoppered bottle.	22	7	Seed good up to 8 months and then rapidly deteriorates.
	(2) Earthen pot..	22	7	
	(3) Gunny bag ..	22	7	
	(4) Air-tight tins.	20	4	
Acacia leucophloea.	(1) Air-tight tins.	8	4	Seed good after 6 months.
Acacia sundra ..	(1) Stoppered bottle.	19	7	Seed good after 9 months.
	(2) Earthen pot..	19	7	
	(3) Gunny bag ..	19	7	
	(4) Mud pot with wood ash.	37	7	Seed good after 8 months falling off slightly by 12 months.
Acrocarpus fraxinifolius.	(1) Gunny bags..	105	25	Seed after 15 months as good as fresh seed.
	(2) Air-tight tins.	20	4	
Albizzia amara ..	(1) Air-tight tins.	13	12	Seed good up to 18 months but does not keep for 2 years, keeps best in (1).
	(2) Mud pot with wood ash.	45	20	
	(3) Gunny bag ..	13	12	
Anacardium occidentale.	(1) Air-tight tins.	12	12	Seed good up to 8 months. Keeps best in (1) or (3).
	(2) Gunny bag ..	32	12	
	(3) Earthen pot..	12	12	
Artocarpus hirsuta..	(1) Gunny bag ..	25	12	Seed good up to 2 months and then rapidly deteriorates, keeps best if in pit covered with 2 inches of dry earth.
Calophyllum elatum.	(1) Gunny bag ..	3	7	Keeps for at least 1 year. In the seed bed it often only germinates in the second year.
Cassia fistula ..	(1) Air-tight tins.	32	12	Seed good up to 16 months except in (1).
	(2) Earthen pots.	12	12	
	(3) Gunny bag ..	12	12	
Cassia marginata ..	(1) Air-tight tins.	16	8	Seed good after 8 months.
Cassia siamea ..	(1) Air-tight tins.	15	12	Seed good after 18 months; but does not keep for 2 years.
	(2) Mud pots with wood ash.	35	12	
	(3) Gunny bag ..	15	12	
Cedrela toona ..	(1) Gunny bag ..	18	6	Seed good up to 8 weeks falling to 50 per cent at 10 weeks.
Chloroxylon swietenia.	(1) Air-tight tins.	56	12	Good up to 3 months and then rapidly deteriorates. No difference between Ceylon and Madras seed.
	(2) Earthen pots.	12	12	
	(3) Gunny bags..	38	12	
Dalbergia latifolia..	(1) Gunny bags..	138	20	Good up to 4 months only.
	(2) Air-tight tins.	56	15	No seed has given any result after one year.
	(3) Earthen pots.	5	7	Good up to 2 months only.
Dalbergia sissoides.	(1) Gunny bags..	3	6	Good up to 3 months and then rapidly deteriorates.
	(2) Air-tight tins.	3	6	
	(3) Wood ash ..	3	6	
Dysoxylum malabaricum.	(1) Dry gunny bag	8	4	Seed good up to 6 weeks—Keeps in wet gunny bag but not in dry gunny bag.
	(2) Wet gunny bag	8	4	
Gluta travancorica.	(1) Gunny bag ..	40	6	Seed good up to 4 months dropping to 50 per cent at 6 months.
Gmelina arborea ..	(1) Gunny bags..	75	15	Variable. Seed usually good up to 6 or8 weeks.
Hopea parviflora ..	(1) Gunny bags..	39	6	Seed good after 20 days falling to 0 after 0 days.
Lagerstrœmia lanceolata.	(1) Gunny bags ..	24	6	Seed good up to 4 months.
	(2) Air-tight tins.	24	6	Seed good up to 6 months.
Mesua ferrea. ..	(1) Gunny bags..	8	2	Seed good up to 5 months dropping to 50 per cent at 7 months.

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Palaquium ellipticum.	(1) Gunny bags..	18	5	Variable—Usually good up to about 2 months.
Prosopis juliflora..	(1) Stoppered bottle.	20	8	Seed good after 7 months.
	(2) Earthen pot..	20	8	
	(3) Gunny bag ..	20	8	
	(4) Air-tight tins.	20	4	
Pterocarpus dalbergioides.	(1) Gunny bags..	10	8	Seed good up to 18 months.
Pterocarpus marsupium.	(1) Gunny bags..	125	18	Variable, usually good up to 6 months sometimes good up to 1 year.
	(2) Air-tight tins.	35	12	
Pterocarpus santalinus.	(1) Gunny bags..	30	7	Good up to 6 months ; indications are that it is good up to 10 months.
	(2) Earthen pot..	21	7	
	(3) Stoppered bottle.	21	7	
Santalum album.	(1) Air-tight tins.	22	7	Seed good up to 9 months.
	(2) Gunny bags..	12	5	
Swietenia macrophylla.	(1) Gunny bags..	37	10	Seed good up to 5 months falling to o at 6 months.
Tectona grandis ..	(1) Gunny bags..	168	26	Seed good up to 1 year but falls to 30 per cent after 2 years. It keeps much better in (1) than in (2).
	(2) Air-tight tins.	53	10	
Terminalia chebula.	(1) Gunny bags..	38	10	Seed good up to 8 months falling to about 50 per cent after 12 months.
	(2) Stoppered bottle.	14	10	
	(3) Earthen pot..	14	10	
Terminalia crenulata (tomentosa).	(1) Gunny bags..	153	22	Seed good up to 5 months, deterorates to 50 per cent by 9 months. Still gives about 10 per cent after 15 months. Keeps best in air-tight tins.
	(2) Stoppered bottle.	38	6	
	(3) Air-tight tins.	23	4	
Terminalia paniculata.	(1) Gunny bags..	33	10	Seed good up to 5 months.
	(2) Stoppered bottle.	33	10	
	(3) Air-tight tins.	33	10	
Xylia xylocarpa ..	(1) Gunny bags..	150	20	Very variable ; usually good up to 3 months.
	(2) Stoppered botle.	42	12	
	(3) Air-tight tins.	42	12	

NOTE.—(1) The above results are indications of the probable longevity of the seed. Many more tests are necessary in most cases before reliable results can be obtained.

(2) The periods in column (5) are the times between collection and sowing and *not* between collection and germination which are often much longer.

(3) Generally 100 seeds were used for each treatment, date and test.

(4) In many cases the remark is given as "Seed good up to × months". Often this is the maximum period tested and not necessarily the maximum period the seed remains fertile.

276. *Seed weighments* (vide paragraph 35)—

Species.	Month in which to collect seed.	Number of: Seeds per ounce.	Number of: Seeds per pound	Number of weighments.	Plant per cent.	Germinative capacity.	Number of tests.	Number of seeds tested.	Plants per pound of seed.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Acacia arabica ..	II–III	204	3,264	5	..	..	..	..	..
Acacia auriculiformis ..	III–IV	1,180	18,880	10	59	67	23	8,600	11,060
Acacia cyanophylla ..	IV	2,010	32,160	5	93	94	12	4,300	29,900
Acacia dealbata ..	I–IV	2,313	37,008	4	33	45	12	1,200	12,180
Acacia ferruginea ..	III	164	2,624	17	80	90	16	4,700	2,020
Acacia leucophloea ..	III–IV	1,115	17,840	20	28	28	19	3,100	4,950
Acacia melanoxylon ..	IV	2,023	32,368	4	78	83	12	1,200	25,000
Acacia planifrons ..	VI	709	11,344	5	18	22	4	4,000	2,040
Acacia sundra ..	II–V	713	11,248	10	90	90	26	6,000	10,260
Acrocarpus fraxinifolius.	III–IV	964	15,424	20	21	25	45	32,000	3,230
Albizzia amara ..	II–IV	378	6,048	20	74	79	30	22,360	4, 50
Albizzia lebbek ..	II–III	333	5,328	15	24	27	8	1,800	1,210
Albizzia stipulata ..	..	1,997	31,952	2	1	8	10	1,000	320
Anacardium occidentale.	III–V	5·4	86	9	98	98	26	5,180	84
Artocarpus hirsuta ..	VI	49	784	63	81	88	42	26,060	630
Azadirachta indica ..	III–VII	134	2,144	10	40	44	11	7,456	856
Bambusa arundinacea..	IV	2,912	46,592	2	37	38	5	1,500	17,200
Bambusa gigantea ..	II	3,475	55,600	1	1	2	2	1,000	555
Bambusa polymorpha..	III	1,326	21,216	3	32	40	22	3,000	6,750
Callitris rhomboidea ..	IV–VI	4,872	77,952	2	18	22	5	500	13,960
Calophyllum elatum ..	V–VI	5	83	22	67	89	23	7,800	55
Canthium didymum ..	IV	360	5,760	10	2	42	3	3,000	115
Cassia fistula	III–V	179	2,864	14	33	44	35	13,600	940

Note.—For germinative capacity and plant per cent the maxima are given.

Species.	Month in which to collect seed.	Number of Seeds per ounce.	Number of Seeds per pound.	Number of weighments.	Plant per cent.	Germinative capacity.	Number of tests.	Number of seeds tested.	Plants per pound of seed.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cassia marginata ..	II-V	133	2,128	13	47	65	21	8,800	997
Cassia siamea . ..	III-IV	1,009	16,144	10	87	98	21	4,300	14,000
Cassia tomentosa ..	II-IV	1,033	16,528	4	8	13	15	1,500	1,320
Castanospermum australe.	IV	1	15	3	53	56	4	350	8
Cedrela toona	V	4,853	77,648	7	62	82	24	10,090	47,800
Chloroxylon swietenia..	III-VI	2,710	43,360	18	64	69	33	26,100	27,600
Chloroxylon swietenia (Ceylon).	III-VII	1,381	22,096	32	58	62	27	30,600	12,780
Citysus scoparius ..	III-IV	3,188	51,008	2	24	30	5	500	12,200
Cupressus macrocarpa ..	IV-VI	4,400	70,400	2	8	8	5	500	5,620
upressus torulosa ..	V-VI	3,840	61,440	1	5	9	5	500	3,072
Dalbergia latifolia ..	I-III	504	8,064	13	55	65	58	40,500	4,440
Dalbergia sissoides ..	III	498	7,968	31	50	65	31	15,500	3,975
Daphniphyllum glaucescens.	V-VI	155	2,480	2	5	8	10	1,000	124
Dendrocalamus strictus.	IV	865	13,840	4	47	48	5	1,500	6,500
Dipterocarpus indicus ..	III-V	5	78	6	20	41	6	3,000	16
Dodonea viscosa ..	II-IV	3,220	54,520	2	12	12	5	500	6,150
Dolichandrone crispa ..	III-IV	846	13,536	10	30	32	8	4,800	4,061
Dysoxylum malabaricum.	VII-VIII	3	50	4	85	85	32	2,435	43
Eucalyptus maculata ..	..	6,112	97,792	2	12	13	2	200	11,730
Eugenia arnottiana ..	VI-VII	111*	1,776	4	71	73	20	2,000	1,260
Erythroxylon monogynum.	I-II	895	14,320	12	2	2	4	1,600	286
Feronia elephantum ..	IV	1,408	22,528	6	1	1	4	4,000	225
Givotia rottleriformis ..	..	16·5	264	5	..	..	..	..	..
Glochidion neilgherrense.	III-IV	1,490	23,840	1	..	3	1	100	..
Gluta travancorica ..	V-VIII	1·9	30	5	90	96	32	6,255	27
Gmelina arborea ..	V-VI	42	672	3	56	64	25	8,500	375
Hakea saligna ..	IX-X	2,436	38,976	4	68	75	12	1,200	26,400
Hardwickia binata ..	V	134†	2,144	5	..	..	..	..	..
Hardwickia pinnata ..	..	4·6	74	1	80	85	5	500	59
Harrisonia bennettii ..	I	278	4,448	3	..	12	3	300	..
Holoptelea integrifolia..	..	1,080	17,280	5	15	17	4	800	2,590
Hopea parviflora ..	V-VII	71	1,136	14	54	68	43	81,200	610
Juniperus procera ..	..	1,384	22,144	4	5	6	12	1,200	1,107
Lagerstroemia lanceolata	III	319	5,104	2	5	10	16	56,000	255
Leucaena glauca ..	I	878	14,048	5	33	38	1	3,000	4,610
Ligustrum neilgherrense.	I-III	812‡	12,992	2	66	74	10	1,000	8,510
Mahonia leschenaultii ..	III-IV	2,100	33,600	1	48	52	1	100	16,200
Meliosma wightii ..	III	127	4,032	1	..	14	1	100	..
Mesua ferrea	..	24	384	4	68	70	10	4,000	260
Michelia nilagirica ..	VI	332	5,312	2	23	24	10	1,000	1,220
Neolitsea zeylanica ..	V-VI	172	2,752	2	17	21	2	200	464
Palaquium eilipticum ..	VII-VIII	8·8	141	8	63	63	22	3,050	89
Pithecolobium dulce ..	..	186	2,976	7	33	46	12	1,200	980
Prosopis juliflora ..	V	933	14,928	15	78	89	20	44,200	11,600
Prosopis spicigera ..	III-IV	569	9,204	12	88	88	7	2,400	8,000
Pterocarpus dalbergioides.	III-IV	48	768	17	29	49	33	9,400	§222
Pterocarpus marsupium.	II-IV	53	848	23	90	97	62	20,400	760
Pterocarpus santalinus..	II-IV	30	479	17	65	88	45	18,800	310
Santalum album ..	X & III-IV	136‖	2,176	34	39	47	32	11,600	842
Schleichera trijuga ..	II	49	784	2	9	10	14	1,400	70
Shorea talura	V	32	510	10	55	64	8	4,500	..
Soymida febrifuga ..	..	388	6,208	5	25	28	8	4,800	1,550
Swietenia macrophylla..	II-III	63	1,008	25	51	69	46	20,800	512
Tamarindus indica ..	II-III	47	752	5	..	..	..	..	..
Tectona grandis ..	II-III	52	832	21	58	62	46	43,800	480
Terminalia chebula ..	XI-II	16	257	16	50	60	39	14,120	¶ 129
Terminalia crenulata ..	II-IV	19	304	11	58	72	68	39,300	176
Terminalia paniculata..	III-IV	782	12,512	50	2	2	86	130,000	250
Vitex altissima ..	XII-I	318	5,088	1	..	..	..	..	..
Vitex littoralis ..	V-VII	88	1,408	2	..	30	3	230	..
Vitex peduncularis ..	VIII	211	3,376	2	1	4	2	1,400	34
Wrightia tinctoria ..	V	809	12.944	10	8	11	4	4,000	1,036
Xylia xylocarpa ..	I-V	90	1,440	11	79	99	52	27,000	1,140
Zizyphus incurva ..	I	116 **	1,856	1	38	55	1	100	700
Zizyphus jujuba ..	III	35	560	5	6	10	4	4,000	34

* With pulp, without pulp 164 to the ounce.
† Kernel only, pods 83 per ounce.
‡ Without pulp, with pulp 508 to the ounce.
§ Seed from the Andamans.
‖ With pulp, without pulp 191 per ounce.
¶ Kernel.
** Without pulp, with pulp 80 to the ounce.

Note.—Seed of *Acrocarpus fraxinifolius*, *Calophyllum elatum*, *Mesua ferrea*, and *Dysoxylum malabaricum* very often only germinates to a small extent in the first year, the main germination often being in the second year.

277. *Sorting seed according to size—Teak* (vide paragraph 37)—

Experiment No. 25, Begur Experimental Garden.

Arrangement—ABCD DCBA repeated ten times in single lines of 10 patches, i.e., 100 patches per treatment.

Espacement—6′ × 3′.

Soil preparation—Patches 1′ diameter and 6″ deep at each stake.

Stock used—

A. District Sample random average 0·5″ diameter—53 seeds per ounce.
B. Selected biggest seed ,, 0·7″ ,, 30 do.
C. ,, medium seed ,, 0·5″ ,, 42 do.
D. ,, smallest ,, 0·3″ ,, 98 do.

Date of sowing—Fifteen seeds per patch sown on 30th April 1934.

Treatment—Normal district weeding.

Experiment No. 128, Topslip Experimental Garden.

Arrangement, etc., as above.

Soil preparation—Crowbar holes.

Stock used—Stumps 0·3″ to 0·6″ diameter, made from the plants resulting from the germination tests of Experiment No. 109 of 1935.

Date of stump planting—10th May 1936.

Measurements in January 1937 show:—

Experiment number.	Treatment.	Date of measurement.	Survival percentage.	Mean height.	Difference of means.	Significance.	
Topslip Experimental Garden—	District sample ..	20th January 1937.	92	24·40 ± 0·94	Control.		
Experiment No. 128.	Selected biggest..	Do	92	23·20 ± 1·09	—1·20 ± 1·44	N.S.	Measurements in inches.
	Selected medium.	Do.	95	23·60 ± 0·94	—0·80 ± 1·33	N.S.	
	Selected smallest.	Do.	86	23·10 ± 1·05	—1·30 ± 1·41	N.S.	
Begur Experimental Garden—	District sample ..	15th December 1936.	85	6·17 ± 0·45	Control.		
Experiment No. 25.	Selected biggest..	Do.	38	8·09 ± 0·50	+1·92 ± 0·67	S.	Measurements in feet.
	Selected medium.	Do.	66	6·92 ± 0·43	+0 75 ± 0·62	N.S.	
	Selected smallest.	Do.	54	7·13 ± 0·51	+0·96 ± 0·68	N.S.	

278. *Size, age and condition of seed bearers—Teak* (vide paragraph 40)—

Wynaad division—Experimental plot 29.

Arrangement—6 blocks of 10 × 10 stakes each 6′ × 6′ arranged

A	B	C
C	B	A

Soil preparation—Crowbar holes.

Stock used—One-year old stumps 0·2″ to 1·0″ diameter from Begur Experimental Garden Experiment No. 46 of 1935.

Treatment—

(A) Stumps 0·52″ average diameter from seed of 10 healthy mature trees 4′ to 6′ G.B.H.

(B) Stumps 0·53″ average diameter from seed of 10 immature trees under 3′ G.B.H.

(C) Stumps 0·52″ average diameter from seed of 10 over-mature hollow trees over 8′ G.B.H.

Date of stump planting—23rd April 1936.

Dhoni Experimental Garden—Experiment No. 101.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·4″ to 0·5″ diameter as above from Dhoni Experimental Garden Experiment No. 92 of 1935.

Date of stump planting—4th April 1936.

Topslip Experimental Garden—Experiment No. 130.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·3″ to 0·8″ diameter as above from Topslip Experimental Garden Experiment No. 110 of 1935.

Date of stump planting—13th April 1936.

Measurement in January 1937—

Locality.	Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Wynaad Experimental Plot No. 29.	Overmature ..	95	12 90±0·49	— 2·90±0·92	S.
	Mature ..	94	15·80±0 78	Control.	..
	Undermature ..	93	15·90±0·59	+ 0·10±0·98	N.S.
Dhoni Experimental Garden—Experiment No. 101	Overmature ..	93	34·30±1·21	— 0·30±1·76	N.S.
	Mature ..	95	34·60±1·28	Control.	..
	Undermature ..	95	42·40±1·69	+ 7·80±2·12	S.
Topslip Experimental Garden—Experiment No. 130	Overmature ..	86	16·83±1·06	— 0·95±1·48	N S.
	Mature ..	86	17·78±1·04	Control.	..
	Under mature ..	79	15·80±0·66	— 1·98±1·39	N.S

279. *Dalbergia latifolia* (vide paragraph 42)—

Dhoni Experimental Garden Experiment No. 103.

Arrangement, etc., as above.

Stock used—(A), (B), (C)—stumps 0·2″ to 0·4″ diameter as above from Dhoni Experimental Garden Experiment No. 93 of 1935.

Date of stump planting—17th May 1936.

Topslip Experimental Garden—Experiment No. 132.

Arrangement, etc., as above.

Stock used—(A), (B), (C)—stumps 0·2″ to 0·3″ diameter as above from Topslip Experimental Garden Experiment No. 113 of 1935.

Date of stump planting—13th April 1936.

Measurements in January 1937—

Locality.	Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Begur Experimental Garden—Experiment No. 103.	Overmature ..	94	17·58±0·57	+ 1·20±0·81	N.S.
	Mature ..	95	16·38±0·57	Control.	..
	Under mature ..	96	13·56±0·52	− 2·82±0·77	S.
Topslip Experimental Garden—Experiment No. 132.	Overmature ..	48	10·38±0·54	− 0·70±0·76	N.S.
	Mature ..	56	11·08±0·54	Control.	..
	Under mature ..	82	11·16±0·64	+ 0·08±0·84	N.S.

280. *Pterocarpus marsupium* (vide paragraph 44)—

Wynaad Experimental Plot No. 31.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·40″ average diameter as above from Begur Experimental Garden Experiment No. 48 of 1935.

Date of stump planting—17th May 1936.

Dhoni Experimental Garden—Experiment No. 102.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·55″ average diameter as above from Dhoni Experimental Garden Experiment No. 90 of 1935.

Date of stump planting—4th April 1936.

Topslip Experimental Garden—Experiment No. 131.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·3″ to 0·7″ diameter as above from Topslip Experimental Garden Experiment No. 112 of 1935.

Date of stump planting—13th April 1936.

Measurements in January 1937—

Locality.	Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Wynaad Experimental Plot 31. ..	Overmature ..	100	17·80±0·64	+ 1·30±0·84	N.S.
	Mature ..	99	16·50±0·54	Control.	..
	Under mature ..	98	16·20±0·52	− 0·30±0·75	N.S.
Dhoni Experimental Garden—Experiment No. 102	Overmature ..	86	25·25 ± 1·36	+ 1·05 ± 1·79	N.S.
	Mature ..	88	24·20 ± 1·17	Control.	..
	Under mature ..	86	17·50 ± 0·76	6·70 ± 1·39	S.
Topslip Experimental Garden—Experiment No. 131	Overmature ..	31	8·78±0·61	4·19 ± 1·03	S.
	Mature ..	69	12·97±0·84	Control.	..
	Under mature ..	34	12·60±1·19	− 0·37 ± 1·45	NS.

281. *Terminalia crenulata* (vide paragraph 46)—

Wynaad Experimental Plot No. 30.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·57″ average diameter as above from Begur Experimental Garden Experiment No. 49 of 1935.

Date of stump planting—17th May 1936.

Dhoni Experimental Garden Experiment No. 104.

Arrangement, etc., as above.

Stock used—(A) (B) (C)—stumps 0·2″ to 0·9″ diameter as above from Dhoni Experimental Garden Experiment No. 91 of 1935.

Date of stump planting—17th May 1936.

Measurements in January 1937—

Locality.	Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Wynaad Experimental Plot No. 30.	Overmature ..	86	26·40 ± 1·07	+ 2·40 ± 1·95	NS
	Mature ..	100	24·00 ± 1·63	Control.	..
	Undermature ..	94	24·10 ± 0·80	+ 0·10 ± 1·81	NS
Dhoni Experimental Garden— Experiment No. 104	Overmature ..	96	51·20 ± 0 82	− 0·60 ± 1·23	NS
	Mature ..	97	51·80 ± 0·91	Control.	..
	Undermature ..	91	50·00 ± 0·89	− 1·80 ± 1·27	NS

282. *Nursery shading experiment* (vide paragraph 48)—

Locality—Emmanur Experimental Garden.

Climate—Hot and dry from March-June.

Rainfall—Thirty inches mostly between July and December.

Arrangement—Shade and open beds adjoining each other—treatments randomised.

Type of shade—Bamboo mats 4′ to 5′ above the ground.

Treatment—Seed-beds watered once per day in dry weather.

Date of sowing—19th April 1936.

Species.	Date of sowing.	Number of tests.	Number of seed per test.	Germinative capacity per cent.		Plant per cent by February 1937.	
				Open.	Shade.	Open.	Shade.
1 *Acacia auriculiformis* ..	19th April 1936.	2	100	6	16	4	13
2 *Acacia ferruginea* ..		..	100	2	5	1	1
3 *Acacia leucophloea* ..		..	100	5	11	4	9
4 *Acacia planifrons* ..		..	100	4	9	2	9
5 *Acacia sundra*		..	200	1	9	1	7
6 *Albizzia amara*		..	100	2	41	0	37
7 *Albizzia lebbek*		..	100	2	36	1	33
8 *Anacardium occidentale* ..		..	200	25	57	6	49
9 *Cassia fistula*		..	200	3	28	1	15
10 *Cassia marginata* ..		..	200	1	30	0	18
11 *Cassia siamea*		..	100	10	21	10	20
12 *Chloroxylon swietenia* .		..	100	..	..	..	..
13 *Dolichandrone crispa* ..		..	100	17	52	12	45
14 *Holoptelea integrifolia* ..		..	100	0	7	0	3
15 *Pithecolobium dulce* ..		..	100	4	38	1	19
16 *Prosopis juliflora* ..		..	200	2	..	1	0
17 *Pterocarpus santalinus* ..		..	200	0	15	0	1
18 *Santalum album*		..	200	0	33	0	20
19 *Soymida febrifuga* ..		..	100	3	1	1	0
20 *Terminalia chebula* ..		..	100	1	13	0	11

283. *Comparison of direct sowing, entire transplanting and stump planting—Dalbergia latifolia* (vide paragraph 65)—

Kannoth Experimental Garden Experiment No. 27.

Arrangement—DTS STD repeated ten times in single lines of ten plants (i.e., 100 plants per treatment).

Espacement—6′ × 3′.

Soil preparation—Sowing patches 1′ diameter and 6″ deep.

Transplanting—1′ cube pits.

Stump planting—crowbar holes.

Stock used—Sowing 10 sections of broken pods per patch.

Transplants—Two years old 10″ to 17″ high.

Stumps—Two years old 0·2″ to 0·3″ diameter.

Date of sowing—19th May 1936.

Transplanting—25th June 1936.

Stumping—24th May 1936.

Treatment—Normal district weeding.

This experiment was done in a ponam crop of hill paddy sown on 16th May 1936.

Treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Sowing	19th January 1937	25	6·12 ± 0·89	Control.	..
Transplanting ..	Do.	97	7·89 ± 0·30	+ 1·77 ± 0·94	NS
Stumping.. ..	Do.	95	8·45 ± 0·33	+ 2·33 ± 0·95	S

284. *Pterocarpus marsupium* (vide paragraph 66)—

Kannoth Experimental Garden Experiment No. 28.

Arrangement, etc., as for *Dalbergia latifolia.*

Stock used—Sowing 10 seed per patch.

Transplanting—Two years' old 16″ to 32″ high.

Stumps—Two years' old 0·4″ to 0·5″ diameter.

Date of sowing—19th May 1936.

Date of transplanting—25th June 1936.

Date of stumping—24th May 1936.

This experiment was done in a ponam crop of hill paddy sown on 22nd May 1936.

Treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Sowing	19th January 1937.	62	4·30 ± 0·27	Control.	..
Transplanting ..	Do.	77	12·42 ± 0·75	+ 8·12 ± 0·79	S
Stumping ..	Do.	95	10·63 ± 0·63	+ 6·33 ± 0·69	S

284-A. *Pterocarpus dalbergioides—Andaman Padauk* (vide paragraph 68)—

Kannoth Experimental Garden Experiment No. 18.

Arrangement, etc., as for *Dalbergia latifolia.*

Stock used—Sowing 10 seeds per patch.

Transplanting—One year old and 27″ high.

Stumps—One year old and 0·4″ to 0·5″ diameter.

Date of sowing—28th May 1936.

Transplanting—18th June 1936.

Stumping—24th May 1936.

Treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	
Sowing	19th January 1937.	6	6·50	Too few survivals for calculation of significance.
Transplanting ..	Do.	54	24·30	
Stumping	Do.	16	11·80	

285. *Terminalia crenulata* (vide paragraph 70)—

Dhoni Experimental Garden Experiment No. 112.

Arrangement, etc., as for *Dalbergia latifolia.*

Stock used—Sowing 10 seeds per patch.

Transplanting—Transplants two months old 5″ to 6″ high.

Stumps—One year old and 0·4″ to 0·5″ diameter.

Date of sowing—18th May 1936.

Transplanting—12th June 1936.

Stumping—18th May 1936.

Topslip Experimental Garden Experiment No. 129.

Arrangement, etc., as above.

Stock used—Sowing 10 seeds per patch.

Transplants—Three months old and 10″ high.

Stumps—One year old and 0·3″ to 0·4″ diameter.

Date of sowing—3rd April 1936.

Transplanting—12th July 1936.

Stumping—3rd April 1936.

Begur Experimental Garden Experiment No. 65.

Arrangement, etc., as above.

Stock used—Sowing 10 seeds per patch.

Transplants—One year old and 6″ high.

Stumps—One year old and 0·4″ to 0·5″ diameter.

Date of sowing—28th May 1936.

Transplanting—11th June 1936.

Stumping—17th May 1936.

Kannoth Experimental Garden Experiment No. 30.

Arrangement, etc., as above.

Stock used—Sowing 10 seeds per patch.

Transplanting—One year old and 12″ high.

Stumps—One year old and 0·45″ diameter.

Date of sowing—19th May 1936.

Transplanting—25th June 1936.

Stumping—24th May 1936.

This experiment was done in a ponam crop of hill paddy sown on 20th May 1936.

Experiment number.	Treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Dhoni Experimental Garden—	Sowing ..	13th January 1937.	84	32·60±1·12	Control.	..
Experiment No. 112.	Transplanting.	Do.	81	32·25 ± 1·06	+2 6 5± 1·54	NS
	Stumping ..	Do.	90	35·38 ± 1·31	+2·78 ± 1·72	NS
Topslip Experimental Garden—	Sowing ..	21st January 1937.	26	31·50 ± 1·21	Control.	..
Experiment No. 129.	Transplanting.	Do.	62	15·95 ± 0·87	−15·55 ± 1·49	S
	Stumping ..	Do.	19	30·30 ± 2·68	− 1·20 ± 2·94	NS
Begur Experimental Garden—	Sowing ..	13th January 1937.	71	15·58 ± 0·65	Control.	..
Experiment No. 65.	Transplanting.	Do.	50	14·06 ± 0·85	− 1·52 ± 1·08	NS
	Stumping ..	Do.	93	27·60 ± 0·62	+ 12·02 ± 0·91	S
Kannoth Experimental Garden—	Sowing ..	19th January 1937.	9	4·22	Too few survivals in sowing and transplanting to work significance.	
Experiment No. 30.	Transplanting.	Do.	19	9·84		
	Stumping ..	Do.	83	11·50		

286. *Artocarpus hirsuta* (vide paragraph 72)—

Kannoth Experimental Garden Experiment No. 14.

Arrangement, etc., as for *Dalbergia latifolia*.

Stock used—Sowing 10 seeds per patch.

Transplants—One year old and 16½″ high.

Stumps—Two years old and 0·45″ diameter.

Date of sowing—23rd May 1936.

Transplanting—25th June 1936.

Stumping—31st May 1936.

Treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Sowing ..	19th January 1937 ..	99	8·31 ± 0·33	Control.	..
Transplanting ..	Do. ..	45	5·28 ± 0·45	—3·03 ± 0·57	S
Stumping ..	Do. ..	83	5·70 ± 0·35	—2·61 ± 0·49	S

287. *Comparison of direct sowing with transplanting different sizes of transplants—Swietenia macrophylla* (vide paragraph 73)—

Dhoni Experimental Garden Experiment No. 117.

Arrangement, etc., as for *Dalbergia latifolia*.

Stock used—Sowing 10 seeds per patch.

Transplants—Two months old 15″, 21″ and 30″ high.

Date of sowing—19th May 1936.

Transplanting—12th June 1936.

Topslip Experimental Garden Experiment No. 137.

Arrangement, etc., as above.

Stock used—*Sowing* 10 seeds per patch.

Transplants—Three months old 6″, 13″ and 26″ high.

Date of sowing—3rd April 1936.

Transplanting—27th May 1936.

Begur Experimental Garden Experiment No. 66.

Arrangement, etc., as above.

Stock used—*Sowing* 10 seeds per patch.

Transplants—(i) and (ii) One year old 15″ and 33″ high, (iii) three months old and 7½″ high.

Date of sowing—28th May 1936.

Transplanting—16th June 1936.

Kannoth Experimental Garden Experiment No. 33.

Arrangement, etc., as above.

Stock used—*Sowing* 10 seeds per patch.

Transplants—(i) Four months old 10½″ high, (ii) one year old and 25″ high, (iii) one year old and 42″ high.

Date of sowing—19th May 1936.

Transplanting—18th June 1936.

This experiment was done in a ponam crop of hill paddy sown on 29th May 1936.

Kannoth Experimental Garden Experiment No. 20.

(Second year measurements.)

Arrangement, etc., as above.

Stock used—*Sowing* 10 seeds per patch.

Transplants—

(i) Six months old 6″ to 9″ high.

(ii) Six months old 12″ to 18″ high.

(iii) Six months old 30″ to 36″ high.

Date of sowing—25th May 1935.

Transplanting—5th July 1935.

This experiment was done in a ponam crop of hill paddy sown on 15th May 1935.

Dhoni Experimental Garden Experiment No. 79.

(Second year measurements.)

Arrangement, etc., as above.

Stock used—Sowing 15 seeds per patch.

Transplants—Two months old 2″ to 5″ high.

Date of sowing—21st May 1935.

Transplanting—22nd June 1935.

Begur Experimental Garden Experiment No. 45.

(Second year measurements.)

Arrangement, etc., as above.

Stock used—Sowing 10 seeds per patch.

Transplants—

(i) One year old 21″ high.
(ii) Four months old 5½″ high.

Date of sowing—20th June 1935.

Transplanting—27th June 1935.

Kannoth Experimental Garden Experiment No. 7.

(Third year measurements.)

Arrangement, etc., as above.

Stock used—Transplants—

(i) Three months old 9″ high.
(ii) One year old 18″ high.
(iii) One year old 30″ high.

Date of transplanting—1st July 1934.

This experiment was done in a ponam crop of hill paddy sown on 22nd May 1934.

Experiment number.	Treatment.	Survival percentage.	Initial height in inches.	Final height in inches.	Increment during the year (in inches).
Dhoni Experimental Garden—					
Experiment No. 117.	Sowing	97	..	20·8	+ 20·8
	Transplanting—				
	(i)	45	15	19·3	+ 4·3
	(ii)	79	21	25·7	+ 4·7
	(iii)	75	30	34·4	+ 4·4
Topslip Experimental Garden—					
Experiment No. 137.	Sowing	77	..	12·40	+ 12·4
	Transplanting—				
	(i)	34	6	11·3	+ 5·3
	(ii)	30	12·5	14·6	+ 2·1
	(iii)	70	26	24·0	— 2.0
Kannoth Experimental Garden—					
Experiment No. 33.	Sowing	84	..	9·5	+ 9·5
	Transplanting—				
	(i)	66	10·5	12·3	+ 1·8
	(ii)	75	25	19·4	— 5·6
	(iii)	85	42	32·3	— 9·7
Begur Experimental Garden—					
Experiment No. 45.	Sowing	87	..	12·20	+ 12·20
	Transplanting—				
	(i)	42	7·5	11·6	+ 4·1
	(ii)	23	15·0	15·0	+ 0·0
	(iii)	87	33	2·6	—10·4

Note.—Negative increment is due to shoot borer attack or dying back.

Second year measurements.

Experiment number.	Treatment.	Survival percentage, second year.	Initial height.	Height after: One year.	Height after: Two years.	Increment: First year.	Increment: Second year.
Kannoth Experimental Garden Experiment No. 20.	Sowing	34	..	9·3″	25·8″	+ 9·3″	+ 16·5
	Transplanting—						
	(i)	64	7·5″	11·8″	35·4″	+ 4·3″	+ 13·6″
	(ii)	83	15″	18·6″	37·0″	+ 3·6″	+ 18·4″
	(iii)	91	33″	29·8″	41·0″	− 3·2″	+ 11·2″
Dhoni Experimental Garden Experiment No. 79.	Sowing	50	..	12·8″	53·1″	+ 12·8″	+ 40·3″
	Transplanting	53	3·5″	15·3″	56·3″	+ 11·8″	+ 41·0″
Begur Experimental Garden Experiment No. 45.	Sowing	28	..	9·5″	36·1″	+ 9·5″	+ 26·6″
	Transplanting—						
	(i)	67	5·5″	10·6″	40·6″	+ 5·1″	+ 30·0″
	(ii)	97	21·1″	24·3″	50·0″	+ 3·2″	+ 26·7″

Third year measurements.

Experiment number.	Treatment.	Survival percentage third year.	Initial height.	Height after: One year.	Height after: Two years.	Height after: Three years.	Increment: First year.	Increment: Second year.	Increment: Third year.
Kannoth Expeimental Garden Experiment No. 7.	Transplants—								
	(i)	50	9″	15·8″	54·4″	89·2″	+ 6·8″	+ 39·6″	+ 34·8″
	(ii)	50	18″	19·8″	53·9″	88·4″	+ 1·8″	+ 34·1″	+ 34·5″
	(iii)	50	30″	25·8″	64·0″	105·3″	— 4·2″	+ 38·2″	+ 41·3″

Note.—Negative increment is due to shoot borer attack or dying back.

288. *Premonsoon stump planting—Teak* (vide paragraph 78)—

Dhoni Experimental Garden Experiment No. 106.

Arrangement—ABCDE EDCBA repeated ten times in single lines of ten plants (i.e., 100 plants per treatment).

Espacement—6′ × 6′.

Soil preparation—Crowbar holes.

Stock used—Stumps from one year old nursery plants.

Dates of stump planting—Fortnightly from 1st April 1936 to 1st June 1936.

Size of stumps—0·5″ to 0·8″ diameter.

Tending—Normal district weeding.

Topslip Experimental Garden Experiment No. 122.

Arrangement, etc., as above.

Stock used—Stumps 0·3″ to 0·5″ diameter made from one year old plants.

Walayar Experimental Garden Experiment No. 4.

Arrangement, etc., as above.

Stock used—Stumps 0·5″ to 0·6″ diameter made from one year old plants.

Begur Experimental Garden Experiment No. 60.

Arrangement, etc., as above.

Stock used—Stumps 0·5″ to 0·6″ diameter made from one year old plants.

Kannoth Experimental Garden Experiment No. 22.

Arrangement, etc., as above.

Stock used—Stumps 0·4″ to 0·5″ diameter made from one year old plants.

Note.—This experiment was done in a ponam crop of hill paddy sown on 29th May 1936.

Growth data after I season.

Experiment number.	Date of planting.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Dhoni Experimental Garden—Experiment No. 106.	A 1st April 1936.	12th January 1937.	93	33.50±2·01	+ 9·30±2·26	S
	B 16th April 1936.	Do.	74	22·60±1·24	— 1·60±1·61	N.S.
	C 1st May 1936.	Do.	85	29·30±1·49	+ 5·10±1·81	S.
	D 15th May 1936.	Do.	99	38·00±1·35	+13.80±1·37	S.
	E 1st June 1936.	Do.	92	24·20±1·03	Control.	..
Topslip Experimental Garden—Experiment No. 122.	A 1st April 1936.	20th January 1937.	42	31·70±2·18	+14·48±2·30	S.
	B 15th April 1936.	Do.	6	23·50±2.99	+ 6·28±3·08	S
	C 1st May 1936.	Do.	49	21·20±1·23	+ 3·98±1·42	S.
	D 15th May 1936.	Do.	96	23·8[illegible]±0·97	+ 6·58±1·21	S.
	E 1st June 1936.	Do.	89	17·22±0·73	Control.	..
Walayar Experimental Garden—Experiment No. 4.	A 2nd April 1936.	16th January 1937.	70	35·86±1·84	+15·56±2·12	S.
	B 17th April 1936.	Do.	53	30·00±1·79	+ 9·70±2·08	S.
	C 2nd May 1936.	Do.	69	26·20±1·45	+ 5·90±1·79	S.
	D 17th May 1936.	Do.	93	33·10±1·16	+12·80±1·56	S.
	E 2nd June 1936.	Do.	67	20·30±1·05	Control.	..
Begur Experimental Garden—Experiment No. 60.	A 1st April 1936.	30th December 1936.	97	22·25±1·40	+12·54±1·47	S.
	B 15th April 1936.	Do.	100	17·66±1·07	+ 7·95±1·16	S.
	C 1st May 1936.	Do.	100	16·83±0·82	+ 7·12±0·93	S.
	D 15th May 1936.	Do.	99	13·42±0·68	+ 3·71±0·81	S.
	E 1st June 1936.	Do.	95	9·71±0·45	Control.	..
Kannoth Experimental Garden—Experiment No. 22.	A 1st April 1936.	19th January 1937.	85	21·70±1·27	+14·13±1·13	S.
	B 15th April 1936.	Do.	93	17·40±0·93	+ 9·83±0·99	S.
	C 1st May 1936.	Do.	96	16·18±0·87	+ 8·61±0·93	S.
	D 15th May 1936.	Do.	96	9·88±0·58	+ 2·31±0·66	N.S.
	E 1st June 1936.	Do.	96	7·57±0·33	Control.	..

289. *Dalbergia latifolia* (vide paragraph 88)—

Dhoni Experimental Garden Experiment No. 108.

Arrangement—ABCDE EDCBA repeated ten times in single lines of 10 plants (i.e., 100 plants per treatment).

Espacement—6′ × 3′.

Soil preparation—Crowbar holes.

Stock used—Stumps from one year old nursery plants.

Date of stump planting—Fortnightly from 1st April to 1st June 1936.

Size of stumps—0·2″ to 0·4″ diameter.

Tending—Normal district weeding.

Topslip Experimental Garden Experiment No. 124.

Arrangement, etc., as above.

Stock used—Stumps 0·1″ to 0·2″ diameter made from one year old plants.

Begur Experimental Garden Experiment No. 61.

Arrangement, etc., as above.

Stock used—Stumps 0·1″ to 0·2″ diameter made from one year old plants.

Kannoth Experimental Garden Experiment No. 23.

Arrangement, etc., as above.

Stock used—Stumps 0·2″ to 0·3″ diameter made from one year old plants.

Note,—This experiment was done in a ponam crop of hill paddy sown on 16th May 1936.

Experiment number.	Date of planting.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Dhoni Experimental Garden—						
Experiment No. 108.	A 1st April 1936.	12th January 1937.	48	13·50±0·94	+ 0·15±1·12	N.S.
	B 15th April 1936.	Do.	30	12·63±1·21	− 0·72±1·35	N.S.
	C 1st May 1936.	Do.	71	13·42±0·84	+ 0·07±1·04	N.S.
	D 15th May 1936.	Do.	95	15·42±0·96	+ 2·07±1·14	N.S.
	E 1st June 1936.	Do.	95	13·35±0·61	Control.	..
Topslip Experimental Garden—						
Experiment No. 124.	A 1st April 1936.	20th January 1937.	72	11·41±0·57	+ 1·41±0·66	S.
	B 15th April 1936.	Do.	57	9·90±0·40	− 0·10±0·53	N.S.
	C 1st May 1936.	Do.	36	10·17±0·53	+ 0·17±0·63	N.S.
	D 15th May 1936.	Do.	91	12·82±0· 3	+ 2·82±0·63	S.
	E 1st June 1936.	Do.	89	10·00±0·35	Control.	..
Begur Experimental Garden—						
Experiment No. 61.	A 1st April 1936.	10th January 1937.	95	10·10±0·36	+ 1·10±0·50	S.
	B 15th April 1936.	Do.	94	11·20±0·46	+ 2·20±0·57	S.
	C 1st May 1936.	Do.	87	11·52±0·43	+ 2·52±0·56	S.
	D 15th May 1936.	Do.	97	9·90±0·38	+ 0·80±0·52	N.S.
	E 1st June 1936.	Do.	95	9·00±0·35	Control.	

Experiment number.		Date of planting.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Kannoth Experimental Garden— Experiment No. 23.	A	1st April 1936.	19th January 1937.	94	11·02±0·73	+ 1·10±1·04	N.S.
	B	15th April 1936.	Do.	80	10·68±0·91	+ 0·76±1·18	N.S.
	C	1st May 1936.	Do.	26	10·00±1·62	+ 0·08±1·78	N.S.
	D	15th May 1936.	Do.	94	11·06±0·84	+ 1·14±1·13	N.S.
	E	1st June 1936.	Do.	94	9·92±0·75	Control.	..

290. *Pterocarpus marsupium* (vide paragraph 89)—

Dhoni Experimental Garden Experiment No. 107.

Arrangement—ABCDE EDCBA repeated ten times in single lines of 10 plants (i.e., 100 plants per treatment).

Espacement—6′ × 3′.

Soil preparation—Crowbar holes.

Stock used—Stumps from one year nursery plants.

Date of stump-planting—Fortnightly from 1st April to 1st June 1936.

Size of stumps—0·3″ to 0·6″ diameter.

Tending—Normal district weeding.

Topslip Experimental Garden Experiment No. 123.

Arrangement, etc., as above.

Stock used—Stumps 0·2″ to 0·5″ diameter made from one year old plants.

Begur Experimental Garden Experiment No. 83.

Arrangement, etc., as above.

Stock used—Stumps 0·3″ to 0·4″ diameter made from one year old plants.

Kannoth Experimental Garden Experiment No. 24.

Arrangement, etc., as above.

Stock used—Stumps 0·3″ to 0·4″ diameter made from one year old plants.

Note.—This experiment was done in a ponam crop of hill paddy sown on 17th May 1936.

Experiment number.		Date of treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Dhoni Experimental Garden— Experiment No. 107.	A	1st April 1936.	12th January 1937.	92	35·20±2·18	+ 4·60±2·56	N.S.
	B	15th April 1936.	Do.	69	22·50±1·42	— 8·10±2·03	S.
	C	1st May 1936.	Do.	75	29·60±1·42	— 1·00±2·03	N.S.
	D	15th May 1936.	Do.	100	37·99±1·74	+ 7·39±2·26	S.
	E	1st June 1936.	Do.	92	30·60±1·45	Control.	..

Experiment number.	Date of treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Topslip Experimental Garden— Experiment No. 123.	A 1st April 1936.	20th January 1937.	26	7·20±0·50	+ 1·00±0·84	N.S.
	B 15th April 1936.	Do.	8	6·50±1·78	+ 0·30±1·41	N.S.
	C 1st May 1936.	Do.	7	8·71±1·32	+ 2·51±1·24	S.
	D 15th May 1936.	Do.	74	6·97±0·37	+ 0·77±0·76	N.S.
	E 1st June 1936.	Do.	91	6·20±0·21	Control.	..
Begur Experimental Garden— Experiment No. 63.	A 1st April 1936.	15th January 1937.	57	12·60±0·90	— 0·95±1·23	N.S.
	B 15th April 1936.	Do.	67	14·12±0·79	+ 0·57±1·16	N.S.
	C 1st May 1936.	Do.	98	17·20±0·75	+ 3·65±1·13	S.
	D 15th May 1936.	Do.	100	15·60±0·65	+ 2·05±1·07	N.S.
	E 1st June 1936.	Do.	98	13·55±0·84	Control.	..
Kannoth Experimental Garden— Experiment No. 24.	A 1st April 1936.	19th January 1937.	46	9·71±1·30	+ 0·57±1·58	N.S.
	B 15th April 1936.	Do.	64	8·29±0·78	— 0·85±1·20	N.S.
	C 1st May 1936.	Do.	52	8·18±0·93	— 0·96±1·17	N.S.
	D 15th May 1936.	Do.	92	12·35±0·81	+ 3·21±1·22	S.
	E 1st June 1936.	Do.	96	9·14±0·91	Control.	..

291. *Terminalia crenulata* (vide paragraph 90)—

Begur Experimental Garden Experiment No. 62.

Arrangement—ABCDE EDCBA repeated ten times in single lines of 10 plants (i.e., 100 plants per treatment).

Espacement—6′ × 3′.

Soil preparation—Crowbar holes.

Stock used—Stumps from one year nursery plants.

Dates of stump-planting—Fortnightly from 1st April to 1st June 1936.

Size of stumps—0·5″ to 0·6″ diameter.

Tending—Normal district weeding.

Kannoth Experimental Garden Experiment No. 25.

Arrangement, etc., as above.

Size of stumps—0·4″ to 0·5″ diameter.

Note.—This experiment was done in a ponam crop of hill paddy sow sown 18th May 1936.

Dhoni Experimental Garden Experiment No. 110.

Arrangement, etc., as above.

Size of stumps—0·4″ to 0·7″ diameter.

Topslip Experimental Garden Experiment No. 125.

Arrangement, etc., as above.

Size of stumps—0·3″ to 0·6″ diameter.

Experiment number.	Date of treatment.	Date of measurement.	Survivalpercentage.	Mean height in inches.	Difference of means.	Significance.
Begur Experimental Garden Experiment No. 62.	A 1st April 1936.	15th January 1937.	81	32·20 ± 1·24	+ 15·07 ± 1·48	S.
	B 15th April 1936.	Do.	96	31·50 ± 1·02	+ 14·37 ± 1·31	S.
	C 1st May 1936.	Do.	85	28·50 ± 0·92	+ 11·37 ± 1·23	S.
	D 15th May 1936.	Do.	99	26·50 ± 0·88	+ 9·37 ± 1·20	S.
	E 1st June 1936.	Do.	89	17·13 ± 0·82	Control.	..
Kannoth Experimental Garden —Experiment No. 25.	A 1st April 1936.	19th January 1937.	78	27·60 ± 1·89	+ 9·55 ± 2·32	S.
	B 15th April 1936.	Do.	88	24·80 ± 2·07	+ 6·75 ± 2·47	S.
	C 1st May 1936.	Do.	84	24·90 ± 2·06	+ 6·85 ± 2·46	S.
	D 15th May 1936.	Do.	94	19·78 ± 1·97	+ 1·73 ± 2·39	N.S.
	E 1st June 1936.	Do.	88	18·05 ± 1·35	Control.	..
Dhoni Experimental Garden —Experiment No. 110.	A 1st April 1936.	12th January 1937.	21	49·10 ± 2·65	+ 14·00 ± 2·87	S.
	B 15th April 1936.	Do.	9	45·78 ± 6·54	+ 10·68 ± 6·63	N.S.
	C 1st May 1936.	Do.	34	42·60 ± 2·06	+ 7·50 ± 2·34	S.
	D 15th May 1936.	Do.	96	51·90 ± 1·06	+ 16·80 ± 1·53	S.
	E 1st June 1936.	Do.	68	35·10 ± 1·10	Control.	..
Topslip Experimental Garden —Experiment No. 125.	A 1st April 1936.	20th January 1937.	33	38·50 ± 1·58	+ 10·50 ± 1·69	S.
	B 15th April 1936.	Do.	7	26·14 ± 2·05	— 1·86 ± 2·13	N.S.
	C 1st May 1936.	Do.	20	32·15 ± 1·94	+ 4·15 ± 2·04	S.
	D 15th May 1936.	Do.	84	30·20 ± 0·84	+ 2·20 ± 1·04	S.
	E 1st June 1936.	Do.	92	28·00 ± 0·61	Control.	..

292. *Artocarpus hirsuta* (vide paragraph 91)—

Begur Experimental Garden Experiment No. 64.

Arrangement—ABCD DCBA repeated five times in lines of 10 plants (i.e., 50 plants per treatment).

Espacement—6′ × 3′.

Soil preparation—Crowbar holes.

Stock used—Stumps from one year nursery plants.

Dates of stump-planting—Fortnightly from 1st May to 1st July 1936.

Size of stumps—0·4″ to 0·5″ diameter.

Tending—Normal district weeding.

Kannoth Experimental Garden Experiment No. 26.

Arrangement, etc., as above.

Dates of stump-planting—Fortnightly from 15th April to 15th June 1936.

Size of stumps.—0·4″ to 0·5″ diameter.

Note.—This experiment was done in a ponam crop of hill paddy sown on 18th May 1936.

Dhoni Experimental Garden Experiment No. 109.

Arrangement, etc., as above.

Dates of stump planting.—Fortnightly from 1st May to 1st July 1936.

Size of stumps.—0·3″ to 0·7″ diameter.

Topslip Experimental Garden Experiment No. 126.

Arrangement, etc., as above.

Size of stumps.—0·2″ to 0·4″ diameter.

Experiment number.	Date of treatment.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Begur Experimental Garden Experiment No. 64.	A 1st May 1936.	13th January 1937.	78	8·39 ± 0·80	+1·64 ± 0·94	N.S.
	B 15th May 1936.	Do.	94	8·24 ± 0·45	+1·49 ± 0·68	S.
	C 1st June 1936.	Do.	88	6·52 ± 0·44	—0·23 ± 0·66	N.S.
	D 15th June 1936.	Do.	98	6·75 ± 0·50	Control.	..
	E 1st July 1936.	Do.	86	4·71 ± 0·31	—2·04 ± 0·58	S.
Kannoth Experimental Garden Experiment No. 26.	A 15th April 1936.	19th January 1937.	10	8·60 ± 2·00	+1·08 ± 2·09	N.S.
	B 1st May 1936.	Do.	22	5·56 ± 1·15	—1·96 ± 1·30	N.S.
	C 15th May 1936.	Do.	90	7·62 ± 0·63	+0·10 ± 0·88	N.S.
	D 1st June 1936.	Do.	90	7·52 ± 0·61	Control.	..
	E 15th June 1936.	Do.	56	4·93 ± 0·16	—2·59 ± 0·63	S.
Dhoni Experimenta Garden Exper ment No· 109.	A 1st May 1936·	12th January 1937.	5	7·60 ± 3·76	—7·12 ± 3·80	N.S.
	B 15th May 1936.	Do.	77	15·00 ± 0·87	+0·28 ± 1·05	N.S.
	C 1st June 1936.	Do.	89	14·72 ± 0·58	Control.	..
	D 15th June 1936.	Do.	82	9·94 ± 0·52	—4·78 ± 0·78	S.
	E 1st July 1936.	Do.	66	9·03 ± 0·65	—5·69 ± 0·87	S.
Topslip Experimental Garden Experiment No. 126.	A 1st May 1936.	20th January 1937.	0	0	0	..
	B 15th May 1936.	Do.	45	4·60 ± 0·34	—0·17 ± 0·45	N.S.
	C 1st June 1936.	Do.	56	4·47 ± 0·29	Control.	..
	D 15th June 1936.	Do.	72	3·73 ± 0·17	—0·74 ± 0·33	S.
	E 1st July 1936.	Do.	64	3·31 ± 0·16	—1·16 ± 0·33	S.

293. *Stump-planting—Effect of age and diameter of stumps—Teak.*—(vide paragraph 92).

Dhoni Experimental Garden Experiment No. 105.

Arrangement.—ABCDEF, FEDCBA repeated ten times in single lines of 10 plants (i.e., 100 plants per treatment).

Espacement—6′ × 6′.

Soil preparation.—Crowbar holes.

Stock used.—Stumps one year and 0·4″ to 0·5″, 0·5″ to 0·6″ and 0·7″ to 0·8″ diameter, and two years old 0·5″ to 0·6″, 0;7″ to 0·8″ and 0·9″ to 1·0″ diameter.

Date of stump-planting.—3rd April 1936.

Tending.—Normal district practice.

Begur Experiment Garden Experiment No. 72.

Arrangement, etc., as above only for eight treatments.

Stock used—

Stumps one year old 0·3″ to 0·4″, 0·5″ to 0·6″, 0·7″ to 0·8″ and 1·0″ to 1·1″ diameter.

Stumps two years old 0·7″ to 0·8″, 1″ to 1·1″, 1·2″ to 1·4″ diameter.

Stumps three years old 1·8″ to 2·0″ diameter.

Date of stump-planting.—5th April 1936.

Topslip Experimental Garden Experiment No. 127.

Arrangement, etc., as above only for eight treatments.

Stock used—

Stumps one year old 0·3″ to 0·4″, 0·4″ to 0·5″, 0·5″ to 0·6″ and 0·6″ to 0·7″ diameter.

Stumps two years old 0·4″ to 0·5″, 0·5″ to 0·6″, 0·6″ to 0·7″ and 0·7″ to 0·8″ diameter.

Date of stump-planting.—6th April 1936.

Experiment number.	Age of stumps.	Diameter of stumps.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Dhoni Experimental Garden Experiment No. 105.	One year.	0·3″–0.4″	12th January 1937.	94	24·40 ± 1·37	— 3·70 ± 2·02	N.S.
		0·5″–0·6″	Do.	95	28·10 ± 1·49	Control.	..
		0·7″–0·8″	Do.	92	27·50 ± 1·46	— 0·60 ± 2·09	N.S.
	Two years.	0·5″–0·6″	Do	96	29·00 ± 1·39	+ 0·90 ± 2·04	N.S.
		0·7″–0·8″	Do.	93	25·70 ± 1·42	– 3·60 ± 2·06	N.S.
		0·9″–1·0″	Do.	93	25·10 ± 1·46	— 3·00 ± 2·09	N.S.
Begur Experimental Garden Experiment No. 72.	One year.	0·3″–0·4″	30th December 1936.	95	13·08 ± 0·92	— 3·95 ± 1·32	S.
		0·5″–0·6″	Do.	98	17·03 ± 0·94	Control.	..
		0·7″–0·8″	Do.	97	16·40 ± 0·77	— 0·63 ± 1·21	N.S.
		1·0″–1·1″	Do.	98	18·02 ± 0·88	+ 0·99 ± 1·25	N.S.
	Two years	0·7″–0·8″	Do.	98	18·78 ± 0·75	+ 1·75 ± 1·20	N S.
		1 0″–1·1″	Do.	99	18·78 ± 0·91	+ 1·75 ± 1·31	N.S.
		1·2″–1·4″	Do.	98	18·78 ± 0·99	+ 1·75 ± 1·36	N.S.
	Three years.	1·8″–2·0″	Do.	87	10·60 ± 0·76	— 6·43 ± 1·21	S.
Topslip Experimental Garden Experiment No. 127.	One year.	0·3″–0·4″	20th January 1937.	22	23·90 ± 2·19	+ 1·00 ± 2·80	N.S.
		0·4″–0·5″	Do.	23	23·60 ± 2·34	+ 0·70 ± 2·92	N.S
		0·5″–0·6″	Do.	36	22·90 ± 1·75	Control.	.
		0·6″–0·7″	Do.	33	28·60 ± 2·21	+ 5·70 ± 2·82	N.S
	Two years.	0·4″–0·5″	Do.	42	19·70 ± 1·93	— 3·20 ± 2·60	N.S.
		0·5″–0·6″	Do.	44	21·06 ± 1·89	— 1·84 ± 2·58	N.S.
		0·6″–0·7″	Do.	51	21·90 ± 1·77	— 1·00 ± 2·48	N.S.
		0·7″–0·8″	Do.	58	24·60 ± 1·66	+ 1·70 ± 2·41	N·S.

294. *Dalbergia latifolia*.—(Vide paragraph 93).

Begur Experimental Garden Experiment No. 73.

Arrangement, etc.—As for teak but for eight treatments.

Espacement.—6′ × 3′.

Stock used—

Stumps one year old 0·1″/0·2″, 0·2″/0·3″ and 0·3″/0·4″ diameter.

Two years old 0·2″/0·3″, 0·3″/0·4″, 0·4″/0·5″, 0·5″/0·6″ and 0·6″/0·7″ diameter.

Date of stump-planting.—16th May 1936.

Dhoni Experimental Garden Experiment No. 116.

Arrangement, etc.—As above but for six treatments.

Stock used—

One year old 0·1″/0·2″, 0·2″/0·3″ and 0·3″/0·4″ diameter.

Two years old 0·3″/0·4″, 0·5/0·6″ and 0·7″/0·8 diameter.

Date of stump-planting.—17th May 1936.

Topslip Experimental Garden Experiment No. 133.

Arrangement, etc.—As above but for four treatments.

Stock used—

Stumps one year old 0·1″/0·2″ and 0·2″/0·3″ diameter.

Stumps two years old 0·2″/0·3″ and 0·3″/0·4″ diameter.

Date of stump-planting.—5th April 1936.

Experiment number.	Age of stumps.	Diameter of stumps.	Date of measurement.	Survival percentage.	Mean height in inches.	Difference of means.	Significance
Begur Experimental Garden Experiment No. 73.	One year	0·1″/0·2″	14th January 1937.	96	9·50 ± 0·54	— 2·58 ± 0·84	S.
		0·2″/0·3″	Do.	94	12·08 ± 0·64	Control.	
		0·3″/0·4	Do.	8	11·62 ± 0·58	— 0·46 ± 0·86	N.S.
	Two years.	0·2″/0·3″	Do.	98	12·70 ± 0·49	+ 0·62 ± 0·81	N.S.
		0·3″/0·4″	Do.	96	14·10 ± 0·53	+ 2·02 ± 0·83	S.
		0·4″/0·5″	Do.	94	14·60 ± 0·46	+ 2·52 ± 0·85	S.
		0·5″/0·6″	Do.	88	15·78 ± 0·79	+ 3·70 ± 1·01	S.
		0·6″/0·7″	Do.	82	15·75 ± 0·56	+ 3·67 ± 0·85	S.
Dhoni Experimental Garden Experiment No. 116.	One year.	0·1″/0·2″	14th January 1937.	97	11·88 ± 0·62	— 3·52 ± 0·96	S.
		0·2″/0·3″	Do.	98	15·40 ± 0·74	Control.	
		0·3″/0·4″	Do.	95	14·60 ± 040	— 0·80 ± 0·84	N.S.
	Two years.	0·3″/0·4″	Do.	100	14·78 ± 0·72	— 0·62 ± 1·03	N.S.
		0·5″/0·6″	Do.	92	17·78 ± 0·74	+ 2·38 ± 1·05	S.
		0·7″/0·8″	Do.	90	18·86 ± 0·99	+ 3·46 ± 1·24	S.
Topslip Experimental Garden Experiment No. 133.	One year.	0·1″/0·2″	21st January 1937.	88	11·82 ± 0·52	Control.	
		0·2″/0·3″	Do.	83	11·91 ± 0·49	+ 0·09 ± 0·71	N.S.
	Two year.	0·2″/0·3″	Do.	89	10.01 ± 0·48	— 1·81 ± 0·71	S.
		0·3″/0·4″	Do.	82	12·19 ± 0·49	+ 0·27 ± 0·71	N.S.

295. *Pterocarpus marsupium.*—(Vide paragraph 94).

Begur Experimental Garden Experiment No. 75.

Arrangement, etc.—As for teak but for eight treatments.

Espacement.—6′ × 3′.

Stock used—

Stumps one year old 0·1″/0·2″, 0·2″/0·3″, 0·3″/0·4″, 0·4″/0·5″, 0·5″/0·6″ and 0·6″/0·7″ diameter.

Two years old 0·5″/0·6″ and 0·6″/0·7″ diameter.

Date of stump-planting.—14th May 1936.

Dhoni Experimental Garden Experiment No. 111.

Arrangement, etc.—As above but for six treatments.

Stock used.—Stumps one and two years old 0·3″/0·4″, 0·5″/0·6″ and 0·7″/0·8″ diameter.

Date of stump-planting.—5th April 1936.

Topslip Experimental Garden Experiment No. 134.

Arrangement, etc.—As above.

Stock used.—Stumps 1 and 2 years old 0·3″/0·4″ and 0·4″/0·5″ diameter.

Date of stump-planting.—5th April 1936.

Experiment number.	Age of stumps.	Diameter of stumps.	Date of measurement.	Survival per centage.	Mean height in inches.	Difference of means.	Significance.
Begur Experimental Garden Experiment No. 75.	One year.	0·1″/0·2″	14th January 1937.	86	12·73 ± 0·88	— 7·93 ± 1·41	S.
		0·2″/0·3″	Do.	72	16·35 ± 1·19	— 4·31 ± 1·62	S.
		0·3″/0·4″	Do.	98	17·70 ± 1·11	— 2·96 ± 1·60	N.S.
		0·4″/0·5″	Do.	100	20·66 ± 1·10	Control.	..
		0·5″/0·6″	Do.	100	22·90 ± 1·36	+ 2·24 ± 1·75	N.S.
		0·6″/0·7″	Do.	94	21·70 ± 1·34	+ 1·04 ± 1·74	N.S.
	Two years.	0·5″/0·6″	Do.	98	23·60 ± 1·81	+ 2·94 ± 2·12	N.S.
		0·6″/0·7″	Do.	98	24·00 ± 1·72	+ 3·34 ± 2·04	N.S.
Dhoni Experimental Garden Experiment No. 111.	One year.	0·3″/0·4″	12th January 1937.	94	34·25 ± 1·57	— 6·25 ± 2·26	S.
		0·5″/0·6″	Do.	96	40·50 ± 1·63	Control.	..
		0·7″/0·8″	Do.	98	42·10 ± 1·49	+ 1·60 ± 2·21	N.S.
	Two years.	0·3″/0·4″	Do.	97	34·40 ± 1·93	— 6·10 ± 2·53	S.
		0·5″/0·6″	Do.	98	33·80 ± 1·78	— 6·70 ± 2·42	S.
		0·7″/0·8″	Do.	97	40·00 ± 2·23	— 0·50 ± 2·76	N.S.
Topslip Experimental Garden Experiment No. 134.	One year.	0·3″/0·4″	21st January 1937.	32	8·95 ± 1·27	+ 1·37 ± 1·39	N.S.
		0·4″/0·5″	Do.	62	7·58 ± 0·56	Control.	
	Two years.	0·3″/0·4″	Do.	36	7·72 ± 0·93	+ 0·14 ± 1·08	N.S.
		0·4″/0·5″	Do.	56	7·47 ± 0·48	— 0·11 ± 0·73	N.S.

296. *Terminalia crenulata.*—(Vide paragraph 95).

Begur Experimental Garden Experiment No. 74.

Arrangement, etc.—As for teak but for eight treatments.

Espacement.—6′ × 3′.

Stock used—

Stumps one year old 0·3″/0·4″, 0·5″/0·6″, 0·7″/0·8″ and 1·0″/1·1″ diameter.

Two years old 0·7″/0·8″, 1·0″/1·1″, 1·2″/1·4″ and 1·4″/1·6″ diameter.

Date of stump-planting.—15th May 1936.

Dhoni Experimental Garden Experiment No. 114.

Arrangement, etc.—As above but for six treatments.

Stock used—

Stumps one year old and 0·3″/0·4″, 0·5″/0·6″ and 0·7″/0·8″ diameter.

Two years old 0·5″/0·6″, 0·7″/0·8″ and 0·9″/1·0″ diameter.

Date of stump-planting.—17th May 1936.

Experiment number.	Age of stumps.	Diameter of stumps.	Date of measurement.	Survival per centage.	Mean height in inches.	Difference of means.	Significance.
Begur Experimental Garden Experiment No. 74.	One year.	0·3″/0·4″	14th January 1937.	86	29·30 ± 1·29	+0·20 ± 1·77	N.S.
		0·5″/0·6″	Do.	98	28·40 ± 1·21	Control.	
		0·7″/0·8″	Do.	88	25·70 ± 1·15	—2·70 ± 1·66	N.S.
		1·0″/1·1″	Do.	74	22·50 ± 1·05	—5·90 ± 1·60	S.
	Two years.	0·7″/0·8″	Do.	78	30·70 ± 1·26	+2·30 ± 1·74	N S.
		1·0″/1·1″	Do.	44	19·30 ± 1·60	− 9·10 ± 2·00	S.
		1·2″/1·4″	Do.	38	19·15 ± 1·54	—9·25 ± 1·96	S.
		1·4″/1·6″	Do.	16	19·88 ± 4·44	—8·52 ± 4·59	N.S
Dhoni Experimental Garden Experiment No. 114.	One year.	0·3″/0·4″	13th January 1937.	92	42·00 ± 1·02	—7·40 ± 1·40	S.
		0·5″/0·6″	Do.	98	49·40 ± 0·96	Control.	
		0·7″/0·8″	Do.	81	46·60 ± 1·50	—2·80 ± 1·81	N.S
	Two years.	0·3″/0·4″	Do.	93	43·50 ± 1·06	—5·90 ± 1·47	S.
		0·5″/0·6″	Do.	84	43·30 ± 1·61	—6·10 ± 1·91	S
		0·7″/0·8″	Do.	52	39·10 ± 2·56	—10·30 ± 2·76	S.

297. *Artocarpus hirsuta.*—(Vide paragraph 96).

Kannoth Experimental Garden Experiment No. 32.

Arrangement, etc.—As for teak but for six treatments.

Espacement.—6′ × 3′.

Stock used—

Stumps one year old 0·1″/0·2″, 0·2″/0·3″ and 0·3″/0·4″ diameter.

Two years old 0·2″/0·3″, 0·3″/0·4″ and 0·4″/0·5″ diameter.

Date of stump-planting.—31st May 1936.

Note.—This experiment was done in a ponam crop of hill paddy sown on 18th May 1936.

Begur Experimental Garden Experiment No. 76.

Arrangement, etc.—As for teak but for nine treatments.

Stock used—

Stumps one year old 0·2″/0·3″, 0·3″/0·4″ and 0·4″/0·5″ diameter.

Two years old 0·3″/0·4″, 0·4″/0·5″, 0·5″/0·6″, 0·6″/0·7″ and 0·8″/1·0″ diameter.

Three years old 1·4″/1·6″ diameter.

Date of stump-planting.—1st June 1936.

Experiment number	Age of stumps.	Diameter of stumps.	Date of measurement	Survival per centage.	Mean height in inches.	Difference of means.	Significance.
Kannoth Experimental Garden Experiment No. 32.	One year.	0·1″/0·2″	19th January 1937.	8	1·75 ± 0·54	— 4·22 ± 0·80	S.
		0·2″/0·3″	Do	56	5·97 ± 0·59	Control.	
		0·2″/0·4″	Do.	94	7·42 ± 0·52	+ 1·45 ± 0·79	N.S.
	Two years.	0·2″/0·3″	Do.	60	3·30 ± 0·36	— 2 67 ± 0·69	S.
		0·3″/0·4″	Do.	64	5·88 ± 0·61	— 0·09 ± 0·85	N.S.
		0·4″/05″	Do.	80	5·63 ± 0·36	— 0·34 ± 0·69	N.S.
Begur Experimental Gard.n Experiment No. 76.	One year.	0·2″/0·3″	19th January 1937.	84	6·40 ± 0·51	— 1·98 ± 0·71	S
		0·3″/0·4″	Do.	92	8·38 ± 0·49	Control.	
		0·4″/0·5″	Do.	94	8·15 ± 0·54	— 0·23 ± 0·73	N.S.
	Two years.	0·3″/0·4″	Do.	92	6·92 ± 0·36	— 1·46 ± 0·61	S.
		0·4″/0·5″	Do.	90	7·49 ± 0·45	— 0·89 ± 0·66	N.S.
		0·5″/0·6″	Do.	86	7·14 ± 0·46	— 1·24 ± 0·67	N.S.
		0·6″/0·7″	Do.	88	8·13 ± 0·49	— 0·25 ± 0·69	N.S.
		0·8″/1·0″	Do.	88	10·20 ± 0·66	+ 1·82 ± 0·82	S.
	Three years.	1·4″/1·6″	Do.	70	9·57 ± 1·02	+ 1·19 ± 1·13	N.S.

298. *Effect of depth of stump-planting—Teak.*—(Vide paragraph 98).

Begur Experimental Garden Experiment No. 79.

Arrangement.—A B C D, D C B A repeated ten times in single lines of ten plants, i.e., 100 per treatment.

Espacement.—6′ × 6′.

Treatment—

(A) planted on 1st April 1936 buried.

(B) planted on 1st April 1936 normal.

(C) planted on 1st June 1936 buried.

(D) planted on 1st June 1936 normal.

Stock used.—One year old stumps 0·5″ to 0·6″ diameter.

Weeding.—Normal district practice.

Dhoni Experimental Garden Experiment No. 115.

Arrangement, etc.—As above.

Stock used.—Stumps one year old 0·5″ to 0·8″ diameter.

Walayar Experimental Garden Experiment No. 5.

Arrangement, etc.—As above.

Stock used.—One year old stumps 0·5″ to 0·7″ diameter.

Topslip Experimental Garden Experiment No. 136.

Arrangement, etc.—As above.

Stock used.—One year old stumps 0·4″ to 0·5″ diameter.

Locality.	Date of planting.	Treatment.	Survival percentage.	Mean height in inches.	Difference of means.	Significance.
Begur Experimental Garden Experiment No. 79.	1st April 1936.	Buried ..	99	32·20 ± 1·33	+ 7·40 ± 1·89	S.
		Normal ..	96	24·80 ± 1·35	Control.	
	1st June 1936.	Buried ..	93	11·25 ± 0·49	— 0·83 ± 0·73	N.S.
		Normal ..	98	12·08 ± 0·54	Control.	
Dhoni Experimental Garden Experiment No. 115.	1st April 1936.	Buried ..	86	37·50 ± 2·17	— 4·75 ± 3·61	N.S.
		Normal ..	33	42·25 ± 2·88	Control.	
	1st June 1936.	Buried ..	92	24·20 ± 1·19	+ 0·10 ± 1·76	N.S.
		Normal ..	94	24·10 ± 1·30	Control.	
Walayar Experimental Garden Experiment No. 5.	1st April 1936.	Buried ..	60	35·30 ± 2·03	+ 2·10 ± 3·38	N.S.
		Normal ..	24	33·20 ± 2·70	Control.	
	1st June 1936.	Buried ..	84	22·10 ± 1·13	+ 1·30 ± 1·71	N.S.
		Normal ..	63	20·80 ± 1·29	Control.	
Topslip Experimental Garden Experiment No. 136.	1st April 1936.	Buried ..	26	23·30 ± 1·81	— 1·90 ± 2·26	N.S.
		Normal ..	68	25·20 ± 1·35	Control.	
	1st June 1936.	Buried ..	94	14·80 ± 0·70	+ 0·32 ± 0·93	N.S.
		Normal ..	88	14·48 ± 0·61	Control.	

299. *Stump-planting—Storage of stumps—Teak.*—(Vide paragraph 100).

Begur Experimental Garden Experiment No. 77.

Arrangement.—A B C D, D C B A repeated ten times in single lines of ten plants (i.e., 100 plants per treatment).

Espacement.—6′ × 3′.

Soil preparation.—Crowbar holes.

Treatment.—Stumps were prepared on 5th March 1936, 15th March 1936, 25th March 1936, 10th April 1936 and planted on 10th April 1936.

Stock used.—One year old stumps 0·5″ to 0·6″ diameter.

Tending.—Normal district weeding.

Begur Experimental Garden Experiment No. 78.

Arrangement, etc.—As above.

Treatment.—Stumps were prepared on 5th April 1936, 10th April 1936, 15th April 1936 and 1st May 1936 and planted on 1st May 1936.

Stock used.—One year old stumps 0·5″ to 0·6″ diameter.

Topslip Experimental Garden Experiment No. 135.

Arrangement, etc.—As above.

Treatment—

Set I.—Stumps were prepared on 5th March 1936, 15th March 1936, 25th March 1936 and 10th April 1936 and planted on 10th April 1936.

Set II.—Stumps were prepared on 5th April 1936, 10th April 1936, 15th April 1936, 20th April 1936, 1st May 1936, and 5th May 1936 and planted on 5th May 1936.

Stock used.—One year old stumps 0·3″ to 0·7″ diameter.

Dhoni Experimental Garden Experiment No. **113.**

Arrangement, etc.—As above.

Treatment.—As above.

Stock used.—One year old stumps 0·4″/0·7″ diameter.

Experiment number.	Date of stump-planting.	Date of measurement.	Days of storage.	Survival percentage.	Mean height in inches.
Begur Experimental Garden—					
Experiment No. 77.	10th April 1926.	30th December 1936.	..	97	19·0
	Do.	Do.	15	53	17·3
	Do.	Do.	25	10	16·9
	Do.	Do.	35	..	..
Do. No. 78.	1st May 1936 ..	Do.	..	97	24·6
	Do. ..	Do.	15	79	15·8
	Do. ..	Do.	20	19	16·1
	Do. ..	Do.	25	34	12·0
Topslip Experimental Garden—					
Experiment No. 135.	10th April 1936.	22nd January 1937.	..	24	21·9
	Do.	Do.	5	14	23·3
	Do.	Do.	15	3	22·3
	Do.	Do.	25	1	24·0
	5th May 1936 ..	Do.	..	83	25·5
	Do. ..	Do.	5	55	22·8
	Do. ..	Do.	15	19	23·4
	Do. ..	Do.	20	6	16·0
	Do. ..	Do.	25	10	18·5
	Do. ..	Do.	30	7	14·0
Dhoni Experimental Garden—					
Experiment No. 113.	10th April 1936.	13th January 1937.	..	38	26·5
	Do.	Do.	15	35	30·7
	Do.	Do.	25	25	33·0
	Do.	Do.	35	9	36·0
	5th May 1936 ..	Do.	5	97	34·0
	Do. ..	Do.	20	26	28·6
	Do. ..	Do.	25	63	34·6
	Do. ..	Do.	30	71	31·2

300. *Effect of taungya (ponam) crops on the growth of teak in a plantation.*—(Vide paragraph 117).

Experimental Plot No. 33, Wynaad division.

Arrangement.—The area of 70 × 40 stakes is arranged in 28 randomized blocks of 10 × 10 stakes each, i.e., four repetitions of seven treatments.

Espacement.—6′ × 6′.

Treatment.—First year (A) Dhall, (B), (C), (D) Ragi, (E), (F), (G) control—no crop.

Dhall sown in patches on 8th June 1936 and harvested in January **1937.**

Ragi broadcast on 19th June 1936 and harvested in November 1936.

Tending.—All plants kept clear of crops in 2′ diameter circles.

Date of planting of teak.—5th April 1936.

Measurements in January 1937.

Sub-plot.	First year treatment.	Survival percentage.	Mean height in inches.	Difference from control.	Significance.
A	Dhall	88	13·50±0·49	0±0·66	N.S.
B	Ragi	100	7·98±0·29	—5·52±0·52	S.
C	Do.	100	8·03±0·29	—5·47±0·52	S.
D	Do.	97	9·20±0·37	—4·30±0·57	S.
E	Control	96	13·37±0·55	—0·13±0·70	N.S.
F	Do.	99	14·43±0·56	+0·83±0·71	N.S.
G	Do.	98	13·50±0·44	Control.	..

301. *Direct sowing in a burned over area—Best season.*—(Vide paragraph 120).

Experiments Nos. 13 *to* 18—*Emmanur Experimental Garden.*

Species.—As shown in the table below.

Arrangement.—A B C D E F, F E D C B A repeated ten times in single lines of 20 patches, i.e., 200 of each treatment.

Espacement.—2′ × 2′.

Soil preparation.—9″ cube pits ash from the burn being worked into each pit.

Stock used.—Ten seeds per patch (*Anacardium occidentale*—three seeds per patch).

Dates of sowing.—On the 1st of each month from June to November 1935.

Treatment.—Clean weeded in 1′ diameter circles round the plants.

Experiment No.	Species.	Measurements on 5th January 1937.	Date of sowing (10 seeds per patch). 1st June 1935.	1st July 1935.	1st August 1935.	1st September 1935.	1st October 1935.	1st November 1935.
13	*Acacia auriculiformis.*	Percentage survivals.	7	18	30	20	8	..
		Mean height in inches.	68·5	64.5	69·2	64·6	72·4	..
14	*Acacia ferruginea.*	Percentage survivals.	46	64	79	68	64	24
		Mean height in inches.	43·4	32·1	31·6	32·4	30·0	36·3
15	*Acacia sundra.*	Percentage survivals.	8	49	67	39	72	26
		Mean height in inches.	39·0	42·8	39·3	35·4	33·3	25·1
1	*Albizzia amara.*	Percentage survivals.	30	71	74	53	26	31
		Mean height in inches.	38·7	26·8	24·3	16·7	24·5	17·7
17	*Anacardium occidentale.* (three seeds per patch).	Percentage survivals.	8	27	39	6	24	3
		Mean height in inches.	11·3	13·2	19·0	15·2	11·3	7·2
18	*Cassia siamea.*	Percentage survivals.	42	56	71	37	29	4
		Mean height in inches.	33·0	28·3	30·0	28·6	29·4	24·4

302. *Experiments Nos.* 84 *to* 89—*Emmanur Experimental Garden* (vide paragraph 121)—

Species.—As shown in the table below.

Arrangement, etc.—As above.

Dates of sowing.—On the 1st of each month from May to November 1936.

Experiment number	Species.	Measurements on 4th January 1937.	Date of sowing (10 seeds per patch).						
			1st May 1936.	1st June 1936.	1st July 1936.	1st August 1936.	1st September 1936.	1st October 1936.	1st November 1936.
84	*Acacia auriculiformis.*	Percentage survivals.	14	20	15	31	28	22	20
		Mean height in inches.	16·3	8·5	3·0	2·8	2·1	1·6	1·5
85	*Acacia planifrons.*	Percentage survivals.	49	72	58	57	76	56	35
		Mean height in inches.	22·2	17·4	10·8	9·3	8·9	3·2	2·3
86	*Acacia sundra* ..	Percentage survivals.	12	41	52	32	76	22	13
		Mean height in inches.	24·4	20·9	13·5	10·8	5·5	2·8	2·7
87	*Albizzia amara* ..	Percentage survivals.	46	76	62	51	50	8	47
		Mean height in inches.	23·1	12·0	8·3	5·8	3·8	2·1	2·1
88	*Anacardium occidentale.*	Percentage survivals.	14	11	9	5	33	49	53
		Mean height in inches.	5·9	5·7	6·0	6·1	5·9	5·2	3·5
89	*Cassia siamea* ..	Percentage survivals	76	44	87	86	83	63	89
		Mean height in inches.	46·0	22·4	18·9	13·8	10·9	3·5	2·7

303. *Direct sowing in a burned over area—Comparison of dry and watered beds* (vide paragraph 113)—

Experiments Nos. 19 *to* 24—*Emmanur Experimental Garden.*

(Supplementary to experiments Nos. 13 to 18.)

Species.—As shown in the table below.

Arrangement.—One nursery bed for each species, each bed divided into 12 parts A B C D E F, F E D C B A each sowing of 100 seeds repeated once.

Soil preparation.—Soil worked 18″ deep and smoothed, bed raised 3″ above ground level.

Stock used.—Two hundred seeds for each treatment.

Date of sowing.—On the 1st of each month from June to November.

Treatment.—Clean weeded throughout.

Watering.—Five gallons per day per bed for the watered beds, dry beds no watering.

Experiment No.	Species.	Bed treatment.	Percentage survivals on 18th January 1937 of seed sown on. 1st June 1935.	1st July 1935.	1st August 1935.	1st September 1935.	1st October 1935.	1st November 1935.
19	*Acacia auriculiformis.*	Watered	5	..	7	4	3	..
		Dry	9	4	7	9	1	..
20	*Acacia ferruginea.*	Watered	58	8	17	32	29	13
		Dry	14	26	34	34	27	7
21	*Acacia sundra.*	Watered	18	10	15	15	21	12
		Dry	18	19	21	39	33	5
22	*Albizzia amara.*	Watered	38	22	35	6	7	23
		Dry	13	13	13	8	13	4
23	*Anacardium occidentale.*	Watered	7	11	..	1	1	..
		Dry	..	1	3	1	1	1
24	*Cassia siamea.*	Watered	30	13	23	18	5	1
		Dry	9	3	15	13	1	..

304. *Experiments Nos.* 90 *to* 95—*Emmanur Experimental Garden* (vide paragraph 124)—

(Supplementary to Experiments Nos. 84 to 89.)

Species as shown in the table below.

Arrangement, etc.—As above.

Dates of sowing.—1st of each month from May to November 1936.

Experiment number.	Species.	Bed treatment.	Percentage of survivals on 21st January 1937 of seed sown on. 1st May 1936.	1st June 1936.	1st July 1936.	1st August 1936.	1st September 1936.	1st October 1936.	1st November 1936.
90	*Acacia auriculiformis*	Watered ..	7	14	9	7	5	2	6
		Dry	8	6	3	10	6	4	4
91	*Acacia planifrons.*	Watered ..	20	6	12	13	12	5	17
		Dry	17	27	25	25	12	8	19
92	*Acacia sundra* ..	Watered ..	22	11	3	1	5	8	24
		Dry	22	20	15	5	9	5	6
93	*Albizzia amara* ..	Watered ..	35	34	32	20	12	5	5
		Dry	38	28	18	14	6	5	15
94	*Anacardium occidentale.*	Watered ..	23	2	12	..	2	2	13
		Dry	13	4	2	..	8	10	23
95	*Cassia siamea* ..	Watered ..	28	25	23	26	25	35	51
		Dry	37	35	29	43	20	20	80

305. *Direct sowing—Comparison of burning and no burning, soil working and no soil working before sowing* (vide paragraph 125)—

Experiments Nos. 42 to 47—Emmanur Experimental Garden.

Species as shown in the table below.

Arrangement.—Plot in the open five 100′ strips side by side, the first and last 6′ wide and the middle 3 strips 12′ wide. The second and fourth strips burned; 4′ buffer lines left between burned and unburned strips, 50 stakes per line in each treatment for each species (i.e., 200 per species per treatment).

Espacement.—2′ × 2′.

Soil preparation in soil worked area, 9″ × 9″ × 6″, ash mixed with the soil—in non-soil worked area, just enough soil working to be able to sow.

Stock used.—Ten seeds per patch.

Date of sowing.—2nd July 1935.

Treatment.—Kept clean weeded throughout.

Note.—In the burned areas brushwood was piled 6′ high and beaten down to 4′ high before burning.

Experiment number.	Species.	Measurement on 16th January 1937.	Area *not* burned. Worked its.	Area *not* burned. No soil working.	Area burned. Worked pits.	Area burned. No soil working.
42	*Acacia leucophloea* ..	Percentage survivals ..	6	6	28	23
		Mean height growth in inches	6.6″	6.5″	8·7″	9·7″
43	*Acacia planifrons* ..	Percentage survivals ..	53	13	60	42
		Mean height growth in inches	23·3″	24·3″	25·1″	22·5″
44	*Albizzia amara* ..	Percentage survivals ..	29	12	52	21
		Mean height growth in inches	15·9″	12·3″	16·1″	12·6″
45	*Cassia siamea* ..	Percentage survivals ..	13	..	76	18
		Mean height growth in inches	28·6″	..	33·5″	27·4″
46	*Dolichandrone crispa*.	Percentage survivals ..	1	1	17	10
		Mean height growth in inches	4·0″	2·5″	9·8″	7·9″
47	*Wrightia tinctoria* ..	Percentage survivals ..	16	9	47	34
		Mean height growth in inches	9·5″	10·2″	21·8″	22·2″

306. *Experiments Nos.* 103 *to* 108—*Emmanur Experimental Garden* (vide paragraph 126)—

Species as shown in the table below.

Arrangement, etc., as above.

Date of sowing.—10th July 1936.

Experiment number.	Species.	Measurement on 20th January 1937.	Area *not* burned. Worked pits.	Area *not* burned. No soil working.	*Area burned.* Worked pits.	*Area burned.* No soil working.
103	*Acacia leucophloea* ..	Percentage survivals.	31	17	24	28
		Mean height growth in inches.	1·6″	1·7″	3·0″	3·1″
104	*Acacia planifrons* ..	Percentage survivals.	30	19	39	34
		Mean height growth in inches.	5·9″	2·7″	10·2″	8·8″
105	*Albizzia amara* ..	Percentage survivals.	50	29	59	45
		Mean height growth in inches.	4·2″	3·8″	10·1″	9·8″
106	*Cassia siamea* ..	Percentage survivals.	61	40	81	78
		Mean height growth in inches.	8·0″	8·2″	11·1″	10·3″
107	*Dolichandrone crispa*.	Percentage survivals.	20	13	37	34
		Mean height growth in inches.	1·7″	1·7″	2·3″	2·5″
108	*Wrightia tinctoria* ..	Percentage survivals.	28	26	80	85
		Mean height growth in inches.	3·0″	3·5″	6·2″	7·4″

307. *Comparison of sowing entire transplanting and* ***stump-planting*** (vide paragraph 127)—

Experiments Nos. 109 *to* 126—*Emmanur Experimental Garden.*

Species as in the table below.

Arrangement.—A B C, C B A repeated ten times in single lines of 10 plants, i.e., 100 per treatment per species.

Espacement.—2′ × 2′.

Soil preparation.—Area burned and ash mixed with the soil, soil worked 9″ × 9″ × 6″ for sowing, 9″ crowbar holes for stump-planting and soil worked 9″ × 9″ × 9″ for transplanting.

Stock used.—Sowing ten seeds per patch, transplanting and stump-planting one year old plants from Emmanur nursery.

Date of sowing.—15th July 1936.

Date of transplanting.—19th October 1936.

Date of stump-planting.—29th September 1936.

Treatment.—Clean weeding in 1 foot diameter circles round the plants.

Measurement in January 1937.

Experiment number.	Species.	Percentage survivals.			Mean height in inches.		
		Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
109	*Acacia arabica*	94	5	..	27·5″	10·0″	..
110	*Acacia ferruginea* ..	62	3	18	31·4″	12·7″	4·6″
111	*Acacia leucophloea* ..	70	..	1	4·1″	4·1″	1·0″
112	*Acacia sundra*	77	..	8	22·8″	..	2·8″
113	*Albizzia amara*	67	46	26	15·7″	4·0″	1·4″
114	*Albizzia lebbek*	73	74	34	5·5″	4·0″	1·5″
115	*Azadirachta indica* ..	60	42	5	17·6″	5·6″	7·0″
116	*Cassia fistula*	49	9	11	2·6″	5·2″	2·6″
117	*Dolichandrone crispa* ..	25	70	53	3·4″	3·7″	2·5″
118	*Feronia elephantum* ..	4	27	14	1·3″	1·1″	1·0″
119	*Hardwickia binata* ..	..	7	..	..	2·1″	..
120	*Holoptelea integrifolia* ..	2	41	31	8·5″	7·1″	3·5″
121	*Prosopis juliflora* ..	59	11	1	30·2″	3·8″	5·0″
122	*Prosopis spicigera* ..	57	1	..	4·1″	2·0″	..
123	*Pterocarpus sontalinus* ..	31	24	..	4·6″	17·2″	..
124	*Soymida febrifuga* ..	..	40	39	..	2·3″	1·8″
125	*Tamarindus indica* ..	29	8	..	7·5″	4·0″	..
126	*Wrightia tinctoria* ..	72	64	61	6·9″	4·3″	4·6″

308. (i) *Stump-planting—Best date,* (ii) *Stump-planting and transplanting—Comparison, and* (iii) *Comparison of transplanting at the commencement of the South-West monsoon and North-East monsoon* (vide paragraph 128)—

Experiments Nos. 26 *to* 31—*Emmanur Experimental Garden.*

Species as in the table below.

Arrangement.—A B C D E F, F E D C B A in single lines of ten plants repeated ten times, i.e., 100 plants per treatment.

Espacement.—2′ × 2′.

Soil preparation.—Crowbar holes for stumps, pits 6″ × 6″ × 12″ for transplants—the area was burned and the ash worked in.

Stock used.—One year old nursery **plants.**

Treatment.—Kept clean weeded.

Dates of stump-planting.—1st July 1935, 1st August 1935, 1st September 1935 and 1st October 1935.

Dates of transplanting.—16th June 1935 and 8th October 1935.

Experiment number.	Species.	Measurement on 12th January 1937.	Stump-planting on: 1st July 1935.	1st August 1935.	1st September 1935.	1st October 1935.	Transplanting on: 16th June 1935.	8th October 1935.
26	*Acacia ferruginea.*	Percentage survivals.	..	..	21	21	..	4
		Mean height.	..	..	18·0″	15·0″	..	31·8″
27	*Albizzia lebbek.*	Percentage survivals.	..	..	20	25	..	8
		Mean height.	..	..	18·7″	14·4″	..	20·1″
28	*Cassia marginata.*	Percentage survivals.	..	..	..	2	..	..
		Mean height.	Too few plants for measurement.					
29	*Cassia siamea.*	Percentage survivals..	..	..	3	6	..	..
		Mean height.	..	..	37·3″	19·8″	..	..
30	*Chloroxylon swietenia.*	Percentage survivals.	11	16	2	1	18	..
		Mean height.	8·6″	7·2″	14·5″	9·0″	7·7″	..
31	*Pterocarpus santalinus.*	Percentage survivals.	..	23	18	5	.	7
		Mean height.	..	10·5″	11·2″	7·0″	..	10·6″

309. *Experiments Nos.* 96 *to* 101—*Emmanur Experimental Garden* (vide paragraph 129)—

Species as in the table below.

Arrangement.—A_1 A_2 B C_1 C_2 D_1 D_2 E_1 E_2 F, F E_2 E_1 D_2 D_1 C_2 C_1 B A_2 A_1, etc., in single lines of 10 plants repeated 10 times, i.e., 100 plants per treatment.

Espacement and *soil preparation* as above.

Stock used.—A_1 C D E_1 1 year old stumps 0·1″ to 0·2″ diameter.

A_2 C_2 D_2 E_2 2 year old stumps 0·15″ to 0·3″ diameter.

B & F 1 year old transplants 12″ to 33″ in height.

Treatment.—Kept clean weeded.

Dates of stump-planting.—1st July 1936, 1st August 1936, 1st September 1936 and 1st October 1936.

Dates of transplanting.—16th June 1936 and 21st October 1936.

Percentage survivals on 20th January 1937.

Experiment number.	Species.	Stump planting on: 1st July 1936.		1st August 1936.		1st September 1936.		1st October 1936.		Transplanting on: 16th June 1936.	21st October 1936.
		A_1	A_2	C_1	C_2	D_1	D_2	B_1	B_2	B	F
96	*Acacia arabica*	..	..	..	..	..	..	..	..	..	1
97	*Acacia ferruginea*	3	..	..	5	3	..	2	15	..	8
98	*Acacia sundra*	2	..	..	1	..	..	1	4	..	10
99	*Azadirachta indica*	..	1	1	13	..	2	..	11	..	46
100	*Feronia elephantum*	3	3	1	..	..	..	1	15	..	28
101	*Soymida febrifuga*	1	..	20	25	15	1	13	25	..	81

310. *Santalum album—Stump-planting—Storage of stumps* (vide paragraph 149)—

Sandal storage experiment done in May and June 1936 at Denkanikota.

Date of stumping.	Date of planting.	Number of days stored.	Age of stumps.	Percentage of sprouting of stumps.			
				Packed in tins.		Packed in gunny.	
				Watered.	Not watered.	Watered.	Not watered.
1936.	1936.						
27th May	27th May	..	2½ to 3 years.	42	16	42	16
	29th May	2	..	32	28	24	4
	31st May	4	..	44	24	16	4
	2nd June	6	..	92	76	44	8
	4th June	8	..	76	68	16	4
	6th June	10	..	40	20	16	8
	8th June	12	..	80	44	8	..
	10th June	14	..	84	72	16	8
	12th June	16	..	80	60	..	..
	14th June	18	..	64	44	20	4
	16th June	20	..	68	32	8	..

Note.—The sprouting varies according to the weather conditions in the period immediately following the planting.

Sandal storage experiment done in October 1936 at Denkanikota.

Date of stumping.	Date of planting.	Number of days stored.	Age of stumps.	Percentage of sprouting of stumps.			
				Packed in tins.		Packed in gunny.	
				Watered.	Not watered.	Watered.	Not watered.
1936.	1936.						
2nd October	22nd October	20	2½ to 3 years.	100	84	..	..
4th October	..	18	..	92	76	..	..
6th October	..	16	..	68	56	..	..
8th October	..	14	..	96	60	..	..
10th October	..	12	..	92	56	..	..
12th October	..	10	..	52	32	..	..
14th October	..	8	..	96	76	..	..
16th October	..	6	..	76	36	..	..
18th October	..	4	..	76	36	52	24
20th October	..	2	..	68	32	36	24
22nd October	..	..	..	94	68	94	68

311. *Leucaena glauca as a cover crop in a teak plantation* (vide paragraph 180)—

Experimental Plot No. 25—Wynaad division.

Arrangement.—A B B A, etc., each treatment being four lines of ten plants repeated five times (i.e., 200 plants of each treatment).

Espacement.—6′ × 6′.

Treatment.—Teak was stump planted in April 1935 after clear-felling and burning, (A) control, (B) *Leucaena glauca* sown on 28th June 1935 in 2′ diameter patches worked 6″ deep in between the teak. One hundred seeds per patch sown.

Tending.—(A) normal district practice, (B) weeded as little as possible—as is essential for the teak or *Leucaena*.

Measurements in January 1937.

Treatment.	Survival percentage.	Mean height in feet.	Difference from control.	Significance.
A. Control	98	6·25 ± 0·32	Control.	..
B. *Leucaena*	98	6·91 ± 0·32	+ 0·66 ± 0·45	NS

312. *Effect of soil working and of trenching on the growth of natural seedlings of Hopea parviflora* (vide paragraph 187)—

Experimental Plot No. 46—South Ciombatore division.

Arrangement.—All undergrowth cleared, all trees except *Hopea parviflora* and *Mesua ferrea* whose crowns were not in the upper canopy were girdled in September 1932. Lines running across the plot 10′ apart arranged A B C, C B A with five repetitions.

Treatments.—(A) soil worked 3″ deep, (B) narrow trenches 3′ apart and 9″ deep were cut so as to sever all roots met with and were then filled in. Similar trenches were cut and filled in across the 3′ strip at intervals of 4′, (C) control—no treatment.

These treatments were repeated annually in January.

Experimental Plot No. 47—South Coimbatore division.

As Experimental Plot No. 46, but under full evergreen cover.

Division.	Experiment number.	Year of formation.	Treatment.	January 1937 measurements. Survival per cent.	Mean height.	Difference of means.	Significance.
South Coimbatore.	46	1933	Soil working.	83	37·10″±3·03″	+10·45″±3·36″	Significant.
			Trenching ..	60	38·60″±3·23″	+12·33″±3·50″	Significant.
			Control ..	86	26·65″±1·45″	Control.	
	47	1933	Soil working.	79	19·43″±1·62″	— 0·35″±2·76″	Not significant.
			Trenching ..	80	18·53″±2·26″	— 1·25″±3·18″	Not significant.
			Control ..	86	19·78″±2·24″	Control.	

313. *Best light and shade conditions for regeneration* (vide paragraph 194)—

Chandanathode Experimental Garden—Experiment No. 65.

Species—

(A) *Swietenia macrophylla.*

(B) *Hopea parviflora.*

(C) *Gluta travancorica.*

(D) *Cedrela toona.*

(E) *Dipterocarpus indicus.*

Arrangement.—Thirty lines of 100 stakes each arranged A B C D E, A B C D E repeated six times in single lines for each species and running from light top canopy shade to full evergreen shade.

Espacement.—3′ × 1½′.

Stock used.—One and two-year old transplants. Initial height of transplants (A) 1·0″, (B) 11″, (C) 10″, (D) 1·3″ and (E) 2″.

Date of transplanting.—6th to 17th September 1934.

Shade conditions—

I. Top canopy only left.

II. Top canopy and high middle storey left.

III. All but undergrowth and low middle storey left.

IV. Full evergreen shade.

Measurements in January 1937, *i.e., after three years.*

Species.	Shade condition.	Survival per cent.	Mean height in inches.	Difference of Means.	Significance.
Swietenia macrophylla ..	I	41	26·90 ± 1·09	Control.	
	II	43	25·10 ± 2·12	—1·80 ± 2·38	N.S.
	III	45	20·13 ± 1·06	—6·77 ± 2·60	S.
	IV	24	19·50 ± 1·49	—7·40 ± 2·72	S.
Hopea parviflora	I	58	22·80 ± 0·79	Control.	
	II	72	25·40 ± 1·60	+2·60 ± 1·78	N.S.
	III	65	22·30 ± 1·16	—0·50 ± 1·40	N.S.
	IV	63	19·60 ± 1·10	—3·20 ± 1·35	S.
Gluta travancorica ..	I	6	27·90 ± 3·21	Control.	
	II	4	25·00 ± 4·34	—2·90 ± 4·33	N.S.
	III	10	21·22 ± 4·23	—6·68 ± 4·22	N.S.
	IV	13	15·00 ± 1·25	—12·90 ± 1·25	S.
Cedrela toona	I	86	48·60 ± 0·96	Control.	
	II	90	54·60 ± 1·97	+6·00 ± 2·19	S
	III	80	46·00 ± 1·95	—2·60 ± 2·17	N.S.
	IV	73	29·80 ± 1·97	—18·80 ± 2·19	S.
Dipterocarpus indicus ..	I	37	17·20 ± 1·02	Control.	
	II	23	15·20 ± 2·10	—2·00 ± 2·34	N.S.
	III	12	10·27 ± 1·87	—6·93 ± 2·09	S
	IV	22	6·00 ± 0·48	—11·20 ± 1·13	S.

314. *Effect of burning in evergreen forest before artificial regeneration of evergreens under top canopy cover* (vide paragraph 197)—

Chandanathode Experimental Garden—Experiment No. 101.

Arrangement.—ABCDEFGHIJKL LKJIHGFEDCBA repeated nine times in lines of 20 stakes (10 burned and 10 unburned), i.e., 90 stakes burned and 90 stakes unburned per species.

Espacement.—3′ × 1½′.

Soil preparation.—Sowing 1′ diameter patches worked 6″ deep.

Transplanting.—1′ cube pits.

Stump-planting.—Crowbar holes.

Cuttings.—Crowbar holes.

Species, method and date of introduction—

A. *Artocarpus hirsuta* stumps 0·3″/0·4″ diameter planted on 17th July 1936.

B. *Swietenia macrophylla* transplants 30″/36″ high.
C. *Artocarpus hirsuta* transplants 18″ high.
D. *Dipterocarpus indicus* transplants 40″/48″ high.
E. *Cedrela toona* cuttings 18″ high.
} planted on 16th July 1936.

F. *Cedrela toona* stumps 0·7″/0·8″ diameter planted on **17th** July 1936.

G. *Hopea parviflora* sowing 10 seeds per patch sown on 9th June 1935.

H. *Hopea parviflora* transplants 30"/36" high planted on 16th July 1936.

I. *Hopea parviflora* transplants 12" high planted on 16th July 1936.

J. *Dysoxylum malabaricum* sowings 5 seeds per patch sown on 9th August 1936.

K. *Dysoxylum malabaricum* transplants 20"/24" high planted on 16th July 1936.

L. *Dysoxylum malabaricum* basketed plants 6"/12" high on 15th August 1936.

Weeding.—Normal district practice.

Karian Shola Experimental Garden—Experiment No. 62.

Arrangement.—Ten burned and ten unburned.

Strips arranged AB, BA, etc. Each strip containing eight lines of ten plants—

One line *Hopea parviflora* transplants 2½" high.
One line *Calophyllum elatum* transplants 9½" high.
One line *Gluta travancorica* transplants 9½" high.
Two lines *Artocarpus hirsuta* transplants 6½" high.
Three lines *Swietenia macrophylla* transplants 19½" high.

The number of plants was thus 100, 100, 100, 200 and 300 for the species in the order given above for each treatment.

Espacement.—3′ × 1½′.

Soil preparation.—9" cube pits.

Date of transplanting.—5th and 13th July 1936.

Weeding.—Normal district practice.

Karian Shola Experimental Garden—Experiment No. 64.

Arrangement.—Burned and unburned strips in the order AB, BA, etc., repeated 16 times in single lines of 10 plants, i.e., 160 plants per treatment.

Espacement, etc., as above.

Stock used.—*Hopea parviflora* natural forest transplants 5½" high.

Date of planting.—7th July 1936.

Experimental garden.		Species.	Unburned. Survival per cent.	Unburned. Mean height.	Burned. Survival per cent.	Burned. Mean height.
Chandanathode Experiment 101.	1	*Artocarpus hirsuta* stumps	62	2·06"	70	2·16"
	2	*Swietenia macrophylla* transplants ..	86	31·20"	84	30·60"
	3	*Artocarpus hirsuta* transplants ..	32	6·40"	26	6·62"
	4	*Dipterocarpus indicus* transplants ..	39	36·20"	53	38·90"
	5	*Cedrela toona* cuttings	56	19·92"	62	20·00"
	6	*Do.* stumps	43	14·38"	56	14·00"
	7	*Hopea parviflora*—sowings	80	2·39"	84	2·28"
	8	*Do.* transplants ..	97	11·39"	95	11·23"
	9	*Do.* do. ..	97	28·50"	97	28·60"
	10	*Dysoxylum malabaricum*—sowings ..	14	5·32"	19	5·37"
	11	*Do.* transplants.	77	18·19"	67	16·83"
	12	*Do.* do.	79	5·32"	92	5·17

Experimental garden.	Species.	Unburned.		Burned.	
		Survival per cent.	Mean height.	Survival per cent.	Mean height.
Kariakshola experiment 62.	1 *Hopea parviflora*—transplants ..	39	3·31″	36	3·52″
	2 *Swietenia macrophylla*—transplants ..	65	21·30″	68	21·50″
	3 *Artocarpus hirsuta*—transplants ..	4	5·04″	2	5·75″
	4 *Gluta travancorica*—transplants ..	25	8·83″	32	7·54″
	5 *Calophyllum elatum*—transplants ..	2	5·75″	2	6·95″
Karianshola Experiment 64.	*Hopea parviflora*—natural forest seedlings.	70	4·04″	73	4·16″
	Average of all species and all experiments.	54	12·42″	57	12·84″

315. *Direct sowing—Best date* (under top canopy only) [vide paragraph 199]—

Chandanathode Experimental Garden—Experiment No. 92.

Species.—Cedrela toona.

Arrangement.—A B C D, D C B A repeated ten times in single lines of ten plants (i.e., 100 per treatment).

Espacement.—3′ × 1½′.

Soil preparation.—Patches 1′ diameter worked 6″ deep.

Stock used.—Ten seeds per patch.

Date of sowing—

(A) 7th May 1936.

(B) 7th June 1936.

(C) 7th August 1936.

(D) 15th September 1936.

Weeding.—Normal district practice.

Chandanathode Experimental Garden—Experiment No. 93.

Species.—Swietenia macrophylla.

Arrangement, etc., as above.

Chandanathode Experimental Garden—Experiment No. 91.

Species.—Acrocarpus fraxinifolius.

Arrangement, etc., as above.

Karianshola Experimental Garden—Experiment No. 52.

Species.—Acrocarpus fraxinifolius.

Arrangement, etc., as above.

Dates of sowing—

(A) 15th June 1936.

(B) 15th July 1936.

(C) 1st August 1936.

(D) 15th September 1936.

Karianshola Experimental Garden—Experiment No. 53.

Species.—Palaquium ellipticum.

Arrangement, etc., as above.

Karianshola Experimental Garden—Experiment No. **54.**

Species.—Swietenia macrophylla.

Arrangement, etc., as above.

Survival percentage in January 1937.

Locality.	Species.	Experiment number.	7th May 1936.	7th June 1936.	7th August 1936.	15th September 1936.
Chandanathode ..	*Cedrela toona*	92	7	5	40	18
	Swietenia macrophylla ..	93	2	..	..	..
	Acrocarpus fraxinifolius ..	91	32	40	35	29
Karianshola ..	*Acrocarpus fraxinifolius* ..	52	21	24	22	7
	Palaquium ellipticum ..	53	11	8	3	1
	Swietenia macrophylla ..	54	9	7	4	..

Mean height growth in January 1937.

Locality.	Species.	Experiment number.	7th May 1936.	7th June 1936.	7th August 1936.	15th September 1936.
Chandanathode ..	*Cedrela toona*	92	3·29″	3·80″	3·28″	2·39″
	Swietenia macrophylla ..	93	4·00″	..	..	..
	Acrocarpus fraxinifolius ..	91	4·03″	3·83″	3·89″	3·34″
Karianshola ..	*Acrocarpus fraxinifolius* ..	52	3·32″	2·98″	3·62″	2·40″
	Palaquium ellipticum ..	53	3·84″	3·81″	4·85″	1·20″
	Swietenia macrophylla ..	54	5·92″	4·80″	5·13″	..

316. *Entire transplanting—Best date* (under top canopy only) [vide paragraph 201]—

Chandanathode Experimental Garden—Experiment No. 94.

Species.—Swietenia macrophylla.

Arrangement.—A B C D E F G, G F E D C B A repeated ten times in single lines of 10 plants (i.e., 100 plants per treatment).

Espacement.—$3' \times 1\frac{1}{2}'$.

Soil preparation.—1′ cube pits.

Stock used.—2-year old plants 18″ to 24″ high.

Dates of transplanting—

(A) 15th June 1936.

(B) 1st July 1936.

(C) 15th July 1936.

(D) 1st August 1936.

(E) 15th August 1936.

(F) 1st September 1936.

(G) 15th September 1936.

Weeding.—Normal district practice.

Chandanathode Experimental Garden—Experiment No. 95.

Species.—Cedrela toona.

Arrangement, etc., as above.

Stock used.—One year old plants 12″ to 24″ high.

Chandanathode Experimental Garden—Experiment No. 96.

Species.—Hopea parviflora.

Arrangement, etc., as above.

Stock used.—One year old plants 12″ to 24″ high.

Chandanathode Experimental Garden—Experiment No. 97.

Species.—Artocarpus hirsuta.

Arrangement, etc., as above.

Stock used.—One year old plants 6″ to 12″ high.

Chandanathode Experimental Garden—Experiment No. 98.

Species.—Calophyllum elatum.

Arrangement, etc., as above.

Stock used.—One year old plants 6″ to 12″ high.

Karianshola Experimental Garden—Experiment No. 56.

Species.—Artocarpus hirsuta.

Arrangement, etc., as above.

Stock used.—One year old plants 5″ to 8″ high.

Karianshola Experimental Garden—Experiment No. 57.

Species.—Swietenia macrophylla.

Arrangement, etc., as above.

Stock used.—One year old plants 18″ to 28″ high.

Karianshola Experimental Garden—Experiment No. 58.

Species.—Calophyllum elatum.

Arrangement, etc., as above.

Stock used.—One year plants 6″ to 14″ high.

Locality.	Experiment number.	Species.	Survival percentage of plants transplanted on						
			15th June 1936.	1st July 1936.	15th July 1936.	1st August 1936.	15th August 1936.	1st September 1936.	15th September 1936.
Chandanathode.	94	*Swietenia macrophylla.*	95	31	69	72	84	93	92
	95	*Cedrela toona* ..	87	65	93	89	90	72	84
	96	*Hopea parviflora.*	94	94	98	96	96	99	67
	97	*Artocarpus hirsuta.*	37	3	7	3	20	25	24
	98	*Calophyllum elatum.*	84	80	76	80	86	64	20
Karianshola ..	56	*Artocarpus hirsuta.*	..	3	1	2	3	14	7
	57	*Swietenia macrophylla.*	86	60	82	84	48	78	60
	58	*Calophyllum elatum.*	2	6	1	2	..	3	..

Locality.	Experiment number.	Species.	Mean height growth in inches of plants transplanted on						
			15th June 1936.	1st July 1936.	15th July 1936.	1st August 1936.	15th August 1936.	1st September 1936.	15th September 1936.
Chandanathode.	94	*Swietenia macrophylla.*	17·40	18·90	21·10	17·50	20·60	18·60	19·90
	95	*Cedreta toona* ..	15·35	13·98	13·06	7·72	6·10	4·96	5·15
	96	*Hopea parviflora.*	17·50	16·55	17·00	17·45	14·10	12·22	12·60
	97	*Artocarpus hirsuta.*	6·95	4·67	3·86	2·67	2·25	4·60	2·63
	98	*Calophyllum eiatum.*	8·83	7·80	6·66	8·60	5·98	5·52	3·20
Karianshola ..	56	*Artocarpus hirsuta.*	..	5·67	1·00	6·50	4·00	3·57	4·14
	57	*Swietenia macrophylla.*	22·40	23·15	24·60	23·20	22·80	23·20	22·44
	58	*Calophyllum elatum.*	6·50	7·33	7·00	8·50	..	7·33	..

317. *Stump-planting—Best date* (under top canopy only) [vide paragraph 202]—

Chandanathode Experimental Garden—Experiment No. 99.

Species.—Artocarpus hirsuta.

Arrangement.—A B C D E , E D C B A repeated ten times in single lines of ten plants (i.e., 100 plants per treatment).

Espacement.—3′ × 1½′.

Soil preparation.—Crowbar holes.

Stock used.—One year old plants, stumps 0·3″ to 0·4″ diameter.

Dates of stump-planting—

(A) 15th May 1936.
(B) 1st June 1936.
(C) 15th June 1936.
(D) 1st July 1936.
(E) 15th July 1936.

Weeding.—Normal district practice.

Chandanathode Experimental Garden—Experiment No. 37.

Species.—Cedrela toona.

Arrangement, etc., as above.

Stock used.—One year old plants, stumps 0·3″ to 0·4″ diameter.

Chandanathode Experimental Garden—Experiment No. 103-*A*.

Species.—Cedrela toona.

Arrangement.—A B . . . . J K K J . . . . B A, etc., repeated four times in lines of 12 plants (i.e., 48 plants per treatment).

Espacement.—1½′ × 1½′.

Soil preparation.—Crowbar holes.

Stock used.—One year old plants, stumps 0·2″ to 0·3″ diameter.

Dates of planting.—Fortnightly from May 1st to October 1st.

Chandanathode Experimental Garden—Experiment No. 104-*A*.

Species.—Artocarpus hirsuta.

Arrangement, etc., as above.

Stock used.—One year old plants, stumps 0·3″ to 0·4″ diameter.

Measurements in January 1937, showed the following:—

Experiment number.	Species.	Survival percentage of stumps planted on										
		1st May 1936.	15th May 1936.	1st June 1936.	15th June 1936.	1st July 1936.	15th July 1936.	1st August 1936.	15th August 1936.	1st September 1936.	15th September 1936.	1st October 1936.
99	*Artocarpus hirsuta.*	..	62	53	66	59	60	..	..	..	..	..
100	*Cedrela toona* ..	..	37	7	18	55	63	..	..	..	..	..
103 A	*Cedrela toona* ..	25	58	20	8	17	54	58	21	2	42	10
104 A	*Artocarpus hirsuta.*	32	35	8	28	15	18	17	5	10	19	21

Experiment number.	Species.	Mean height growth in inches of stumps planted on										
		1st May 1936	15th May 1936.	1st June 1936.	15th June 1936.	1st July 1936.	15th July 1936.	1st August 1936.	15th August 1936.	1st September 1936.	15th September 1936.	1st October 1936.
99	*Artocarpus hirsuta.*	..	1·78	2·17	2·12	2·10	2·17	..	..	..	..	..
100	*Cedrela toona.*	..	6·20	5·43	6·22	5·72	7·89	..	..	..	..	..
103 A	*Cedrela toona.*	4·99	5·57	3·40	3·75	2·64	4·08	2·40	4·50	1·00	1·45	5·20
104 A	*Artocarpus hirsuta.*	2·27	2·24	2·38	1·65	1·43	1·66	1·71	2·00	2·50	1·96	1·96

318. *Comparison of sowing, transplanting small, medium and large transplants and stumping with small and large stumps (under top canopy cover)* [vide paragraph 203]—

Arrangement for all experiments, A B C, etc., etc., C B A, repeated ten times in single lines of ten plants (i.e., 100 per treatment).

Espacement for all experiments 3′ × 1½′.

Soil preparation for all experiments—
Sowing 1′ diameter patches worked 6″ deep.
Transplanting 1′ cube pits.
Stumping crowbar holes.

Weeding for all experiments.—Clean weeding.

I.—*Artocarpus Hirsuta.*

Chandanathode Experimental Garden—Experiment No. 46.

Stock used—

(A) Sowing 10 seeds per patch (12th June 1934).

(B) Transplants 6″ high one year old (20th August 1934).

(C) Transplants 12″ high one year old (20th August 1934).

(D) Stumps 0·22″ diameter one year old (20th August 1934).

(E) Stumps 0·10″ diameter one year old (20th August 1934).

Chandanthode Experimental Garden—Experiment No. 67.

Stock used—

(A) Sowing 10 seeds per patch (10th June 1935).

(B) Transplants 7·6″ high one year old (19th August 1935).

(C) Transplants 16″ high one year old (19th August 1935).

(D) Stumps 0·2″ diameter one year old (19th August 1935).

(E) Stumps 0·45″ diameter one year old (19th August 1935).

Chandanathode Experimental Garden—Experiment No. 84.

Stock used—

(A) Sowing 10 seeds per patch (3rd June 1936).

(B) Transplants 8″ high one year old (25th July 1936).

(C) Transplants 22″ high two years old (25th July 1936).

(D) Transplants 32″ high two years old (25th July 1936).
(E) Stumps 0·25″ diameter (25th July 1936).
(F) Stumps 0·45″ diameter (25th July 1936).

Karianshola Experimental Garden—Experiment No. 60.
Stock used—
(A) Sowing 10 seeds per patch (26th March 1936).
(B) Transplants 7″ high three months old (17th June 1936).
(C) Transplants 25″ high one year old (17th June 1936).
(D) Stumps 0·2″ diameter three months old (17th June 1936).
(E) Stumps 0·4″ diameter one year old (17th June 1936).

II.—*Acrocarpus Fraxinifolius.*

Chandanathode Experimental Garden—Experiment No. 85.
Stock used—
(A) Sowing 10 seeds per patch (3rd June 1936).
(B) Transplants 7½″ high one year old (6th August 1936).
(C) Transplants 18″ high one year old (6th August 1936).
(D) Stumps 0·6″ diameter one year old (6th August 1936).
(E) Stumps 1·5″ diameter three years old (6th August 1936).

Karianshola Experimental Garden—Experiment No. 51.
Stock used—
(A) Sowing 10 seeds per patch (15th June 1936).
(B) Transplants 5″ high three months old (17th September 1936).

III.—*Cedrela Toona.*

Chandanathode Experimental Garden—Experiment No. 49.
Stock used—
(A) Sowing 15 seeds per patch (12th June 1934).
(B) Transplants 7″ high one year old (1st August 1934).
(C) Transplants 11″ high one year old (1st August 1934).
(D) Stumps 0·46″ diameter one year old (1st August 1934)

Chandanathode Experimental Garden—Experiment No. 69.
Stock used—
(A) Sowing 10 seeds per patch (10th June 1935).
(B) Transplants 8½″ high one year old (18th August 1935).
(C) Transplants 20″ high one year old (18th August 1935).
(D) Stumps 0·5″ diameter one year old (19th August 1935).
(E) Stumps 0·27″ diameter one year old (19th August 1935).

Chandanathode Experimental Garden—Experiment No. 89.

Stock used—

(A) Sowing 10 seeds per patch (3rd June 1936).

(B) Transplants 9″ high one year old (23rd July 1936).

(C) Transplants 30″ high one year old (23rd July 1936).

(D) Stumps 0·25″ diameter one year old (23rd July 1936).

(E) Stumps 0·7″ diameter one year old (23rd July 1936).

Karianshola Experimental Garden—Experiment No. 55.

Stock used—

(A) Sowing 10 seeds per patch (15th June 1936).

(B) Transplants 7″ high three months old (17th September 1936).

(C) Transplants 15″ high one year old (17th September 1936).

(D) Transplants 27″ high one year old (17th September 1936).

IV.—*Swietenia Macrophylla.*

Chandanathode Experimental Garden—Experiment No. 47.

Stock used—

(A) Sowing 10 seeds per patch (12th June 1934).

(B) Transplants 8½″ high five months old (1st August 1934).

(C) Transplants 16″ high one year old (1st August 1934).

Chandanathode Experimental Garden—Experiment No. 68.

Stock used—

(A) Sowing 10 seeds per patch (10th June 1935).

(B) Transplants 6″ high four months old (18th August 1935).

(C) Transplants 18″ high one year old (18th August 1935).

(D) Transplants 35″ high one year old (18th August 1935).

Chandanathode Experimental Garden—Experiment No. 86.

Stock used—

(A) Sowing 10 seeds per patch (3rd June 1936).

(B) Transplants 6″ high four months old (23rd June 1936).

(C) Transplants 18″ high one year old (23rd June 1936).

(D) Transplants 35″ high two years old (23rd June 1936).

Karianshola Experimental Garden—Experiment No. 32.

Stock used—

(A) Transplants 36½″ high one year old (17th August 1934).

(B) Transplants 16½″ high one year old (17th August 1934).

(C) Transplants 4″ high two months old (17th August 1934).

Karianshola Experimental Garden—Experiment No. 45.

Stock used—

(A) Transplants 8·5″ high five months old (20th August 1935).
(B) Sowing 5 seeds per patch (1st July 1935).

Karianshola Experimental Garden—Experiment No. 59.

Stock used—

(A) Sowing 10 seeds per patch (17th June 1936).
(B) Transplants 7″ high four months old (17th June 1936).
(C) Transplants 14″ high one year old (17th June 1936).
(D) Transplants 30″ high one year old (17th June 1936).

V.—*Hopea Parviflora.*

Chandanathode Experimental Garden—Experiment No. 48.

Stock used—

(A) Sowing 15 seeds per patch (12th June 1934).
(B) Transplants 9″ high one year old (16th August 1934).
(C) Transplants 20″ high two years old (16th August 1934).

Karianshola Experimental Garden—Experiment No. 48.

Stock used—

(A) Transplants 7·7″ high one year old (21st July 1935).
(B) Transplants 3·4″ high one year old (21st July 1935).

VI.—*Gluta Travancorica.*

Chandanathode Experimental Garden—Experiment No. 87.

Stock used—

(A) Sowing 10 seeds per patch (not done).
(B) Transplants 13″ high two years old (6th August 1936).
(C) Transplants 28″ high two years old (6th August 1936).
(D) Stumps 0·4″ to 0·8″ diameter four years old (6th August 1936).

VII.—*Calophyllum Elatum.*

Chandanathode Experimental Garden—Experiment No. 90.

Stock used—

(A) Transplants $7\frac{1}{2}$″ high two years old (6th August 1936).
(B) Transplants 28″ high two years old (6th August 1936).

VIII.—*Mesua Ferrea.*

Chandanathode Experimental Garden—Experiment No. 88.

Stock used—

(A) Transplants $7\frac{1}{2}$″ high one year old (6th August 1936).

IX.—*Araucaria Cunninghamii.*

Karianshola Experimental Garden—Experiment No. 63.

Stock used—

(A) Transplants 4″ high 18 months old (5th July 1936).

Species.	Locality.	Experiment number.	Year of formation.	Percentage survivals in January 1937. Sowings.	Small transplants.	Medium transplants.	Large transplants.	Small stumps.	Large stumps.	Whether initial difference in height between small, medium, or large transplants has been increased (I), maintained (M) or decreased (D).
Artocarpus hirsuta.	Chandanathode ..	46	1934	29	35	53	..	40	73	D.
	..	67	1935	93	65	67	..	53	52	D.
	..	84	1936	4	..	..	3	3	5	..
	Karian shola ..	60	1936	68	7	..	29	..	80	D.
Acrocarpus fraxinifolius.	Chandanathode ..	85	1936	42	12	48	..	48	60	D.
	Karianshola ..	51	1936	6	18	..	..	..	..	..
Cedrela toona ..	Chandanathode ..	49	1934	3	49	70	..	57	..	I.
	..	69	1935	28	98	..	73	17	40	I.
	..	89	1936	10	75	..	55	39	23	I.
..	Karianshola ..	55	1936	41	65	77	68	..	..	M.
Swietenia macrophylla.	Chandanathode ..	47	1934	..	24	40	..	..	..	D.
	..	68	1935	3	47	79	58	..	..	D.
	..	86	1936	..	59	72	77	..	..	M.
	Karianshola ..	32	1934	..	79	48	6	..	..	D.
	..	45	1935	29	76	..	..	..	..	..
	..	59	1936	2	28	58	69	..	..	D.
Hopea parviflora.	Chandanathode ..	48	1934	3	..	86	84	..	..	D.
..	Karian shola ..	48	1935	..	23	44	..	..	..	M.
Gluta travancorica.	Chandanathode ..	87	1936	..	..	38	32	..	..	D.
Calophyllum elatum.	Chandanathode ..	90	1936	..	76	..	4	..	..	D.
Mesua ferrea ..	Chandanathode ..	88	1936	..	82	..	..	..	..	..
Araucari acunninghami.	Karianshola ..	63	1936	..	95	..	..	..	..	..

319. *Transplanting under top canopy shade—Comparison of natural forest seedlings and nursery transplants* (vide paragraph 204)—

Karianshola Experimental Garden—Experiment No. 49.

Species.—Hopea parviflora.

Arrangement.—A B B A repeated ten times in single lines of ten plants (i.e., 100 plants per treatment).

Espacement.—$3' \times 1\frac{1}{2}'$.

Soil preparation.—1′ cube pits.

Stock used—

(A) Nursery transplants one year old 5″ high.

(B) Natural forest seedlings 5″ high.

Date of transplanting.—21st July 1935.

Treatment.—Kept clean-weeded.

Chandanathode Experimental Garden—Experiment No. 78.

Species.—Palaquium ellipticum.

Arrangement, etc., as above but 200 plants per treatment.

Stock used—

(A) Nursery transplants three years old 17″/36″ high.

(B) Natural forest seedlings 17″/36″ high.

Date of transplanting.—24th August 1935.

Measurements in January 1937 showed—

Species.	Experiment.	Year of formation.	Survival percentage.		Mean height in inches.	
			Nursery transplants.	Natural forest plants.	Nursery transplants.	Natural forest plants.
Hopea parviflora ..	Karianshola 49 ..	1935	18	28	6·06″	5·89″
Palaquium ellipticum.	Chandanathode 78.	1935	10	28	21·70″	22·00″

320. *Comparison of naked root transplanting and basket planting* (vide paragraph 205)—

Karianshola Experimental Garden—Experiment No. 33.

Species.—Dipterocarpus indicus.

Arrangement.—A B, B A repeated ten times in single lines of ten plants (i.e., 100 plants per treatment).

Espacement.—3′ × 1½′.

Soil preparation.—1′ cube pits.

Stock used—

(A) Two months old transplants 3·3″ high.

(B) One month transplants were basketed on 29th July 1934 and when the baskets were planted the plants were 3·0″ high.

Date of transplanting.—17th August 1934.

Treatment.—Kept clean weeded.

Karianshola Experimental Garden—Experiment No. **61**.

Species.—Gluta travancorica.

Arrangement, etc.—As above.

***Stock** used*—

(A) Transplants 6″ high seven months old.

(B) Transplants 9″ high seven months old.

(C) Transplants 12″ high seven months old.

(D) Basketed plants 6½″ high seven months old.

Date of transplanting.—18th June 1936.

Karianshola Experimental Garden—Experiment No. **73**.

Species.—Vateria indica.

Arrangement.—A B, B A repeated 11 times in single lines of five plants (i.e., 55 plants per treatment).

Espacement, etc., as above.

Stock used—

(A) Transplants $7\frac{1}{2}''$ high four months old.

(B) Transplants $18\frac{1}{2}''$ high four months old.

(C) Basketed plants 10″ high four months old.

Date of transplanting.—2nd October 1936.

Measurements in January **1937.**

Species.	Experiment number.	Treatment.	Survival percentage.	Mean height in inches.
Dipterocarpus indicus ..	33	Basket planting	42	11·07″
		Transplanting	11	12·01″
Gluta travancorica	61	6″ Transplants	13	6·40″
		9″ Transplants	15	9·24″
		12″ Transplants	16	12·44″
		$6\frac{1}{2}''$ Basket plants	91	7·49″
Vateria indica	73	$7\frac{1}{2}''$ Transplants	75	10·60″
		$18\frac{1}{2}''$ Transplants	73	14.90″
		10″ Basketed plants	86	9·00″

321. *Propagation by cuttings—Best date of planting* (vide paragraph 207)—

Chandanthode Experimental Garden—Experiment No. 103-*B*.

Species.—*Cedrela toona.*

Arrangement.—A B . . . . . J K K J . . . . . B A, etc., repeated four times in single lines of 12 stakes (i.e., 48 plants per treatment).

Espacement.—$1\frac{1}{2}' \times 1\frac{1}{2}'$.

Stock used.—Cuttings 18″ long from nursery plants one year old.

Dates of planting.—Fortnightly from May 1st to October 1st 1936.

Treatment.—Kept clean weeded throughout.

Measurements in January 1937 showed the following :—

	Cuttings planted on.										
	1st May 1936.	15th May 1936.	1st June 1936.	15th June 1936.	1st July 1936.	15th July 1936.	1st August 1936.	15th August 1936.	1st September 1936.	15th September 1936.	1st October 1936.
Survival percentage.	..	13	17	4	46	81	36	46	94	33	13
Mean height in inches.	..	8·67	11.38	18·00	14·32	14·38	13·90	10.60	6·12	5·20	6·17

322. *List of insects released in Mass infection cages at Denkanikota and at Javalagiri during the year* 1936–37—(Vide paragraph 214).

Type number of insects.	Number of insects released.	
	Denkanikota cage.	Javalagiri cage.
1	6	734
2	10	12
3	56	26
4	235	563
5	72	75
6	..	..
7	441	39
8	18	13
9	496	32
10	1,568	215
11	274	1,058
12	3,751	344
13	1,158	1,840
14	134	27
15	200	34
16	..	110
17	23	97
18	2,153	135
19	2,061	149
20	162	28
21	218	60
22	151	685
23	650	639
24	25	310
25	1,530	394
26	469	532
27	75	8
28	201	58
29	151	33
30	577	125
31	20	3
32	109	51
33	38	114
34	27	4
35	55	40
36	3	4
37	1	1
38	1	2
39	256	31
40	1	25
41	1	20
42	810	134
43	2	12
44	7	16
45	2	7
46	101	30
47	..	..
48	16	81
49	..	66
50	9	17
51	68	2
52	6	9
53	6	8
54	20	1
55	157	41
56	8	4
57	11	..
58	125	140
59	93	107
60	150	43
61	18	90
62	385	52
63	53	76
64	2	11
65	76	11
66	46	1
67	986	119
68	43	34
69	79	550
70	25	12
71	145	91
72	62	35
73	..	2
74	903	274
75	624	104
76	958	2
77	74	14
78	3	5
79	88	7
80	120	75
81	4	..
82	2	..
83	20	..
84	4	..
85	221	338
86	19	3
87	6	2
88	3	..
89	794	20
90	18	255
91	..	..
92	24	9
93	57	100
94	2	1
95	7	5
96	434	76
97	..	13
98	2	1
99	1	..
100	..	2
101	17	2
102	20	6
103	30	..
104	1	9
105	7	11
106	3	..
107	1	..
108	9	21
109	16	2
110	6	1
111	3	..
112	75	9
113	284	37
114	5	19
115	35	3
116	20	19
117	11	..
118	5	..
119	2	..
120	13	1
121	..	..
122	25	11
123	4	..
124	54	1
125	..	..
126	84	5
127	9	5
128	39	2
129	1	6
130	37	..
131	7	..
132	1	38
133	455	296
134	134	11
135	4	..
136	23	9
137	..	..
138	4	3
139	2	..
140	29	2
141	55	..
142	78	124
143	..	..
144	4	6
145	..	..
146	1	6
147	..	..
148	7	5
149	1	..
150	63	3
151	..	..
152	925	91
153	..	..
154	6	5
155	19	3
156	46	29
157	6	4
158	17	16

List of insects released in Mass infection cages at Denkanikota and at Javalagiri during the year 1936–37—(Vide paragraph 214)—cont.

Type number of insects.	Number of insects released. Denkanikota cage.	Number of insects released. Javalagiri cage.
159	20	2
160	32	2
161	3	7
162	2	..
163	214	308
164	36	3
165	2	8
166	..	1
167	1	1
168	101	53
169	31	23
170	39	1
171	23	1
172	15	4
173	19	..
174	874	46
175	149	8
176	13	29
177	4	..
178	279	8
179	115	16
180	2	..
181	1	..
182	116	313
183	1	..
184	1	..
185	97	50
186	63	15
187	4	11
188	44	1
189	..	..
190	19	2
191	2	..
192	..	3
193	14	..
194	2	..
195	2	3
196	3	1
197	3	5
198	9	..
199	114	3
200	52	2
201	1	1
202	206	3
203	17	3
304	43	71
205	11	2
206	..	..
207	..	..
208	3	..
209	3	..
210	72	41
211	..	2
212	7	1
213	..	..
214	3	..
215	11	..
216	24	3
217	..	..
218	..	1
219	..	3
220	..	..
221	..	109
222	33	6
223	4	..
224	6	[illegible]
225	..	..
226	..	1
227	..	..
228	15	3
229	..	..
230	1	3
231	..	2
232	181	5
233	131	4
234	96	20
235	1	..
236	10	4
237	..	..
238	90	4
239	..	..
240	5	18
241	3	2
242	4	..
243	5	19
244	21	17
245	151	41
246	6	13
247	65	8
248	95	2
249	..	..
250	4	4
251	21	..
252	9	..
253	1	..
254	225	62
255	22	..
256	278	49
257	1	..
258	4	5
259	5	3
260	1	22
261	24	..
262	2	1
263	22	..
264	..	..
265	..	..

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